THE NEW SCIENCE LABORATORIES AT UNIVERSITY COLLEGE, LONDON.

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Read at the General Meeting, Monday, 26th February 1894; and, with the illustrations, registered at Stationers' Hall as the property of the Royal Institute.

The President, J. Macvicar Anderson, in the Chair.

THE BUILDINGS.

Mr. President and Gentlemen,—

THE object of this Paper is to describe the additions and alterations which have recently been carried out at University College, London, in order to form a series of laboratories, buildings devoted to the practical study of science and applied science. These laboratories are, it is hoped, sufficiently extensive and complete to be worthy the attention of members of this Institute at a time when technical scientific teaching is one of the prominent subjects of the day.

University College has again and again been a pioneer in the cause of technology, and it has sometimes happened there, as to other pioneers, that those who have followed have been able to remedy some of the imperfections which have been found in the original installations. This has been emphatically the case with engineering. The first engineering laboratory set up for teaching purposes in the United Kingdom was that established by Professor Kennedy in the year 1878 at this College, in a basement not well lighted, certainly spacious, but with no other special adaptation to the purpose than that it had a solid floor; and most of the numerous engineering laboratories which have been since established have had far better buildings provided for them. It is for the many students now working in this department, which has thriven exceedingly, that a new and suitable laboratory, together with a spacious and light studio for mechanical drawing, was urgently required.

Side by side with the needs of the department of mechanical engineering stood the even more pressing ones of a sister department—that of electrical engineering, which was so cramped for room that it was impossible for it to make any progress; and for this section of the College work it was accordingly decided to make proper provision at the same time.

A third branch of study, not so specialised, but at the very root of all technical work of a scientific kind, is physics. The Professor of this science was but indifferently lodged. His classes had not room enough, and they occupied parts of the building which had been designed for other purposes, and were so ill fitted to the requirements of physical observation and experiment that there was no room in his department where the equilibrium of a delicate balance would remain undisturbed if any one walked across the floor! It was accordingly

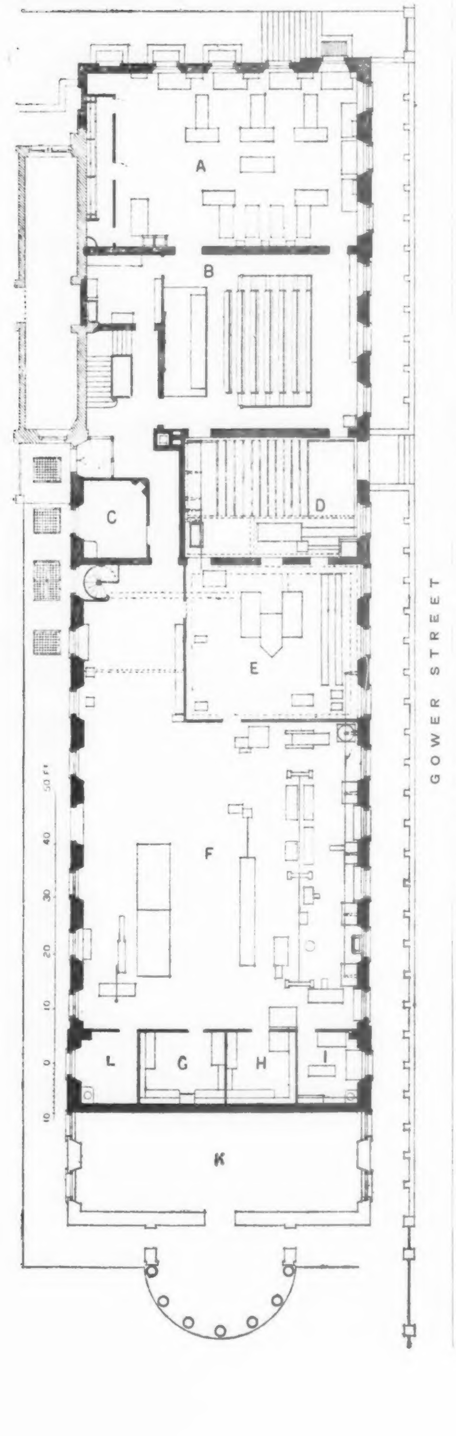


FIG. 1.—GROUND FLOOR OF ENGINEERING AND ELECTRICAL DEPARTMENT.

A, Electrical laboratory with photometric gallery and photographic dark-room adjoining. B, Electrical Professor's lecture-room with apparatus-room adjoining. C, Electrical Professor's private room. D, Dynamo-room, with special entrance from Gower Street. E, Engineering Professor's experimental engine-room. F, Engineering Professor's general laboratory. G, Cement-testing room. H, Calorimeter-room. I, Office. K, Future extension. L, Engineering Professor's private room. The general entrance adjoins room C. The hatched walls show the end of University College School.

almost as pressing a necessity to provide new quarters for physics as for mechanical engineering and for electricity.

It was not difficult to estimate the amount of floor area which should be provided for each of these departments, but it was less easy to settle where and how that floor area was to be formed, for the extent of the required space was great, and it was indispensable that much of it should be on the solid. Where heavy machinery is to be fixed, its bed must rest on the earth. Where the most sensitive and delicate of instruments are to be used, it is necessary to avoid any chance of vibration, and here again the earth is the best base. There is also great practical advantage in having as many of the rooms belonging to the same department as possible all on the same floor; and, without going through all the stages of the careful consideration given to the matter, I may state that there was absolutely no choice. No unoccupied land remained at the disposal of the Council on which a building supplying what was required could be erected, except a small part of the south quadrangle in the rear, and the space along the western or Gower Street front of the great front quadrangle.

The new physical laboratory, which however furnished only a small part of the accommodation needed for physics, was accordingly erected in the rear, and to the electrical and engineering laboratories part of the front space was allotted.

Designs were made providing for the largest amount of space compatible with retaining an adequate opening in the centre of the new front; and of these Mr. Brewer has been good enough to make two views (one of which is given in the illustration facing page 288), which give a general idea of what is contemplated. Very nearly the whole of one block occupying the southern half of the long frontage had to be commenced in order to afford as much ground-floor space

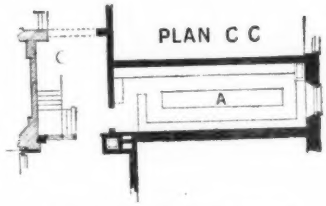
as was wanted; but, unfortunately, only part of the upper floors was called for at the time, and financial considerations absolutely prohibited anything more being done than it was essential to do, with the result that much of the building is temporarily roofed in as a one-storey building, so that externally the new laboratories look very unfinished indeed; but each of the departments actually constructed has been entirely completed internally, and has been, or is being, equipped in the most thorough manner down to the minutest points.

In the architectural treatment of the building the details of the original have been most scrupulously followed, and towards the quadrangle the original ordonnance is in every respect continued. Towards Gower Street some small variations of great practical utility have been made, the most considerable being the introduction of a third storey of openings along part of the front.

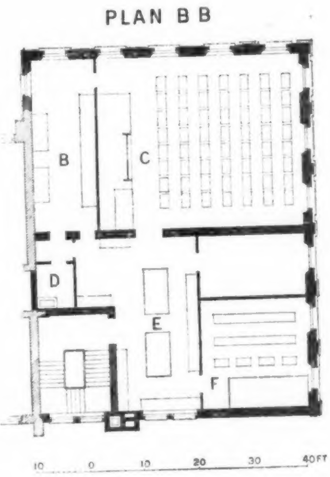
We now turn to the disposition of the laboratories as built [fig. 1]. The engineering laboratory consists of a building 98 feet by 50 feet internal measurement, with four small rooms cut off from it at the north end, and a large space for the steam-engine enclosed by a glass partition, the remainder being quite open and full of machinery and tools. The walls are lined with white glazed bricks. There is ample light. The laboratory is covered by a very light temporary roof of steel trusses, slated on boarding and felt, and with a sky-light. The floor is a wood-block floor on concrete, and where the lathes and other large tools come, blocks of cement concrete were put in to receive them. Cast-iron brackets to carry shafting were built into the walls, and gas, water, and electric light are laid on. There is no basement under the laboratory, but one is formed under the buildings adjoining.

In this basement there is a forge, and at the basement level, but not under any part of the building (so as to avoid any possible risk to the fabric from explosions), is formed the vault for a boiler-house. Also in the basement, but extremely well lighted owing to a fall in the ground, is placed a large carpenters' shop, available for all the engineering students. In the basement there are also lavatories and a heating chamber. As the management and testing of the boiler is part of the training of the students, a spiral staircase connects the boiler-house directly to the laboratory.

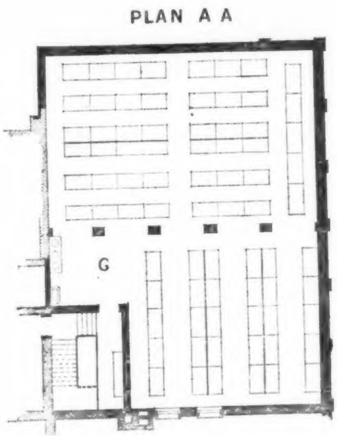
On the first floor [fig. 2, B B], over the electrical department, a lecture theatre and a class-room and professor's private room are provided. The Professor of Graphics as well as the Professor of Engineering lectures here. Behind the lecture theatre a large diagram-room has been formed,



BASEMENT ELECTRICAL DEPARTMENT.
A, Accumulator-room.



FIRST FLOOR ENGINEERING DEPARTMENT.
B, Apparatus-room. C, Lecture-room. D, Photographic developing room, with dark lobby. E, Museum. F, Lecture-room, with private room for Professor of Graphics.



SECOND FLOOR ENGINEERING DEPARTMENT.
G, Engineering drawing-office, top-lighted.

FIG. 2.

and adjoining it is a dark room with a dark lobby for photography. A museum serves as ante-room to all these rooms, with the double advantage that no space is wasted in corridors, and that the students cannot help seeing the specimens as they pass to and from their lectures and classes.

The whole of the second or topmost floor [fig. 2, A A] is devoted to engineering-drawing, and graphics. My own architectural and constructional drawing classes, which the Carpenters' Company maintain, also meet three evenings in the week in this room. This studio, for such it is, is chiefly top-lighted, and provides a floor area of 3,140 feet super including the staircase, which it is fair to include if these figures are to be used as suggestive in other cases. Each student has a desk 5 feet 6 inches by 2 feet 8 inches, with a drawer for instruments and a stool for his own use, and 82 students are provided for, giving 38 feet per student for the space required in this department. A sink for washing palettes and three hand-basins are provided.

The total floor area provided in these buildings on all floors is 19,215 feet, and, assuming the number of engineering students (electrical and mechanical together) at 120, the floor space for each will stand at 160 feet. The mechanical engineering students, however, occupy more space owing to their drawing-room, and owing also to the ample floor required by their engines; and for each of them, assuming the number at 80, we have had to provide 182 feet of floor.

In the lecture theatres the seating is as follows: The floor is flat, which I personally consider undesirable in a lecture theatre, but which the professors who use it desired. The total floor area of the mechanical theatre is 1,181 feet, divided among 56 students, or 21 feet to each. In the electrical theatre, 1,120 feet among 54 students gives nearly 21 feet to each. The electrical theatre is not seated with separate benches, but the large floor area is occasioned in part by the large free gangway which is allowed all round the raised gallery. At the back this gangway is 8 feet wide, and affords room for a long working-bench under the windows, while the back of the gallery is adapted for the preparation of diagrams on a large scale. The gallery seats are 2 feet 6 inches from back to back, and each student has 24 inches of desk. In the physical theatre, to which I shall presently have to refer, the Professor desired to reserve a considerable space near the lecture table for models and apparatus. The total floor space is 1,166 feet, divided among 79 students, giving to each one 14½ feet. It should be pointed out that in all these lecture theatres the rows of seats for students are straight, and not arranged amphitheatrically on plan. Experience shows that this answers best.

Returning now to the ground storey, I will describe the remainder—the southern half—of that floor [fig. 1]. This half is dedicated to electrical engineering. Here again, thanks to the good judgment of Professor Fleming, who knew exactly what provision he wanted, we have been able entirely to avoid corridors, except one short length of entrance corridor and lobby leading to the door of the engineering laboratory and to the staircase. Three divisions occupy the space: (1) The electrical laboratory at the south end, a large and very light room; (2) the lecture theatre, with its apparatus-room; and (3) the dynamo-room. It is quite true that the lecture theatre forms a passage room, but this arrangement the Professor deliberately adopted as consistent with the manner in which he would work his department, and it has helped in the elaboration of a very compact plan.

The laboratory is a large room measuring 50 feet by 32, having a dado of wood 6 feet high, and the walls above that level lined with gault bricks. In order to secure quietness and to keep out the dust the windows are double, and blinds which will completely shut out the light are fitted to them. Some difficulty was experienced in obtaining a material sufficiently opaque; but an admirably dense fabric was at last supplied by Messrs. Guynan, known as "opaque" cloth, and specially prepared for such purposes.

Strong and thick stone slabs for tables are built into each pier at about table height, and form steady tables to carry various measuring instruments. Similar slabs are provided in the north wall, and all windows have them in place of the usual window-board. This has been found to be an excellent way of obtaining a perfectly trustworthy support for delicate apparatus. Were the wall subject to vibration, of course this method would be useless, but the greater part of it is remote from the road, and even where it is parallel to Gower Street it does not seem at all affected by traffic—thanks, no doubt, to our having had to go down to a depth of considerably over 20 feet below the street-level in order to reach a sufficiently good foundation, and to our having an open area between the wall and the street extending downwards below the level of the basement floor.

Channels were constructed in the floor of this room, along which the leads of electric wire can be conducted to the spots where they are wanted, and in the walls composition bricks are built in at intervals, to enable any fittings which have to be secured to the walls to be readily fixed. An iron rail on wrought-iron brackets goes round the walls as near the top as possible, for hanging arc lamps. At the east end of this room is the photometric gallery, a long and narrow room, perfectly dark, and with the whole of the walls, ceiling and fittings painted a dead black, in which the intensity of various kinds of light is measured. A small photographic developing room is attached to this gallery.

The lecture theatre has an apparatus-room lit by electric light quite close to the lecturer's platform, and the channel for conveying wires to the laboratory passes absolutely under his table, so that any connections required for lecture purposes can be made with the utmost facility—indeed, the keynote of the whole disposition is that the Professor at his lecture table has his whole department round him and can literally touch the wires leading to and from everywhere. Even the darkening of the windows of his lecture-room can be done from the table.

Adjoining is the dynamo-room, where the electricity is generated. Here a large pair of gates has been formed to admit of heavy machinery coming in and out. (It may be worth while to add that a similar provision is made in the engineering laboratory, but, for sufficient reasons, in the east wall.) The floor of the dynamo-room is a most important part of the structure. It was not simply necessary to afford a good solid base for the gas-engine and the various dynamos, but it was also essential to have the means of moving the latter about, or changing them for machines of other construction; and above all was it essential so to construct the foundation that as little vibration as possible should pass into the other parts of the building, whatever the speed at which these engines were driven.

After a good deal of consultation the following mode of construction was adopted. After excavating the solid earth to the required depth, a mass of 2 feet of Portland cement concrete was laid over the entire floor, with an extra depth for the bed of the gas engine; but it was prevented from touching the walls anywhere, a space of 2 inches being left clear all round, which was afterwards closely packed with slag wool. In this concrete were embedded the anchor-plates of long holding-down bolts, and in order to secure the absolute accuracy of their position a skeleton template of the whole floor was prepared. By the help of these bolts a series of teak beams, each 6 inches by 4 inches, of a dovetailed section, was secured on the upper surface of the concrete 18 inches apart; the spaces between the teak beams were then filled in with granolithic cement slightly channelled on the surface, to assist in the running-off of water. A 6-inch channel is left almost all round the room for electric light mains, and is provided with a teak cover.

On the teak beams the engineers find fixing for their machinery, and can readily change its position if they need. The power from the gas engine is conveyed to the dynamos through shafting secured to the walls on iron brackets, but fortunately no vibration is occasioned by this

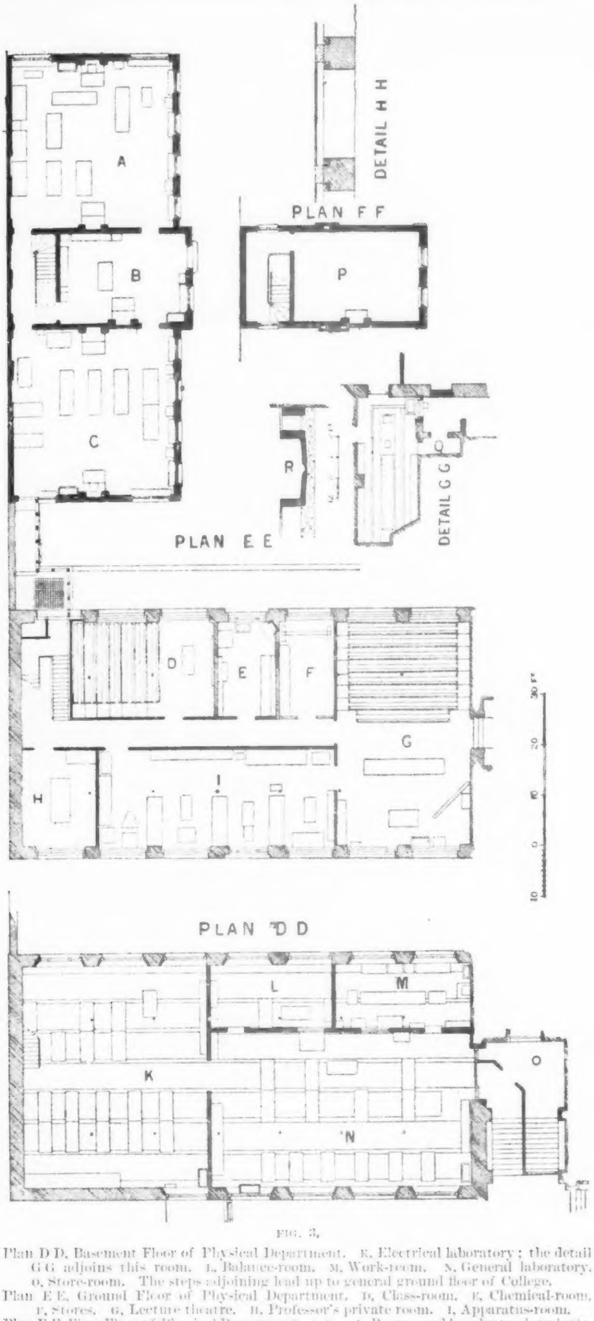


FIG. 3.

Plan D D. Basement Floor of Physical Department. K, Electrical laboratory; the detail G G adjoins this room. L, Balance-room. M, Work-room. N, General laboratory. O, Store-room. The steps adjoining lead up to general ground floor of College.
Plan E E. Ground Floor of Physical Department. D, Class-room. E, Chemical-room. F, Stores. G, Lecture theatre. H, Professor's private room. I, Apparatus-room.
Plan F F. First Floor of Physical Department. A, B, C, P, Rooms used by advanced students.
Detail G G. Accumulator-room adjoining basement. Q, Entrance to accumulator-room from area.
Detail R, Section through floor and benches of dynamo-room; this also applies to fig. 2, A.
Detail H H, Section through floor of basement.

arrangement, which allows of power being conveyed to the engine-room of the engineering laboratory, if needed. The usual throbs of a gas engine, which are often felt to long distances in a building, are also absent, partly because the engine itself is a good one, and partly because its exhaust is conducted into a silencing chamber constructed according to Professor Fleming's directions. This chamber consists of a cylindrical iron vessel partly sunk in the floor and filled with large stones, and appears to answer its purpose admirably.

The accumulator-room [fig. 2, C C] is an important part of an electrical installation, and as the storage batteries give off acrid fumes its ventilation is a matter of importance. It is placed in the basement, and is entered by double doors. We arranged to bring the chimney-flue from the furnace of the hot-water apparatus close to it; we carried up a separate air-flue with an inlet at the ceiling-level of the room to be ventilated, alongside of this furnace-flue, and, thanks to the fact that the flue is a high one, and to the stimulus which the draught in it receives from its neighbour, we have set up a very efficient outgoing current which carries off any unpleasant smells very briskly. A kind of stillage is formed of slabs of oiled slate laid upon half-brick continuous walls of blue brick in cement to carry the accumulators [fig. 3, R], and a floor with sufficient slope for water to run off freely is laid with blue bricks, and with channels of similar material. All the woodwork of this room is painted with anti-sulphuric enamel paint.

The staircase has been constructed with an open well-hole from bottom to top, and a girder has been thrown across it at the highest ceiling-level, so that experiments on long wires or cords may be carried out. It is constructed of Walker's artificial stone, and one of the steps, formed with a small steel joist as a core, was tested by building it into a solid wall and weighting it heavily at the end, and was subsequently destroyed by dropping heavy weights on to it from a height. Its endurance before cracking showed very considerable strength, and the stubbornness and tenacity which it exhibited after its first crack, and before it was finally destroyed, gave me a very high opinion of the value of this material for the landings and staircases of a public building. It may, perhaps, be well to take this opportunity of devoting a few words to an account of the other materials employed, though nothing unusual was attempted. The walls generally are executed in brickwork in cement, the bricks being Fletton bricks, faced with Portland stone, and they stand on Portland cement concrete. We sank a trial pit, and from the results it gave anticipated that we should have to go, chiefly through made earth, for more than 20 feet for a foundation, but fortunately in one part of the building an excellent bed of gravel was reached nearer the surface. Possibly this had elsewhere been dug out in early days. The roofs are slated. Fireproof construction was not judged necessary in the floors, which are carried on steel girders.

The works were let in three separate contracts; each, curiously enough, was gained in limited competition by a different firm. Messrs. Bush built the engineering block, Messrs. Brown, Son, & Bloomfield the new physical laboratory, and Messrs. Titmas & Sons altered the old buildings, and in each case the work was very satisfactory.

I now propose briefly to describe the provision made for the large department of physics. This consists partly of the old engineering laboratory, and the first-floor rooms and lecture theatre above it, all being altered and recast, and partly of a new building on the ground level connected to both floors of the adapted old building by a covered way, which has been already alluded to.

The chief interest to an architect of this part of the work lies in the degree in which it was possible to improve the lighting of what had hitherto been a dark—or at best a very unequally lighted—department. In several places it was possible to enlarge the window openings by lowering the sills. In most it was found possible largely to increase the access of light by splaying the window heads outside or the jambs inside, and as the walls are very thick a really remarkable increase of light was obtained. To a great extent the old walls were refaced with white glazed tiles instead of plaster, and where new walls were built they were faced with white glazed bricks, and the result of the two operations has been to secure an increase of light which adds to a remarkable extent to the serviceableness of the buildings.

The new laboratory is a simple brick building, with a few mouldings executed in moulded brick round the openings, and many windows. It contains on the ground storey [fig. 3, A, C, B] two large laboratories and a central room. On the first floor [fig. 3, F] there is one room and a photographic dark room completely fitted up. It may be noticed that a long stretch of space can be obtained against the rear wall by setting open the doors, and that a window occurs at the end of such space. This has been arranged to admit of experiments on rays of horizontal light of considerable length. All round the walls solid stone tables similar to those already described are built in, and gas is taken to every working table. The floor is solid, resting on the earth, and is happily remote from any causes of disturbance. The floor of a large laboratory in the basement storey of the old building is also practically a solid one, but formed specially, since the earth had been a good deal disturbed. Sleeper walls at a distance of 6 feet apart were carried from end to end of the laboratory, carrying stout stone curbs, the top of which is flush with ordinary wooden flooring [fig. 3, detail H H]. The working

tables are all constructed with legs of such a space apart as to rest on these curbs, while the students and assistants stand on the wooden flooring between, and in this way the steadiness of the tables is secured. The amount of floor space appropriated to the department of physics is 11,273 feet, of which 3,117 is in the new laboratory, and 8,156 in the adapted building. Out of this total of 11,273 feet of flooring no less than 6,813 is carried on the solid earth.

The heating of the new physical laboratory is carried out by means of the Falkirk Iron Company's controlled combustion stoves, and by open fireplaces in the smaller rooms. The rest of this department is heated from the low-pressure system which warms the college buildings generally. In the new wing it was decided to employ a "medium pressure" apparatus, and though my prejudices are not in favour of this method, I am bound to admit that the ease with which it can be introduced into every part of the building, and the large amount of heat which it throws out, are very much in its favour, and that those who make use of this department are satisfied with the results, the only complaint as yet being that the staircase and lobby are too hot.

All the three new departments are lit by electric light, and Professor Fleming has made all the arrangements for, and supervised the carrying out of, a very successful installation.

Having completed my account of the new buildings, there remain only the fittings, so far as the architect had to control them, which seem to require a brief notice. The fittings used in the engineering department include some which are simple, and require no special description. The desks in the lecture theatre have been newly designed, and are arranged so that each student has a separate desk large enough to make small drawings in addition to taking the ordinary lecture notes, and are so spaced as to give the Professor ready means of supervising the drawings. The top of the desk is sloped [fig. 4], and measures 2 feet 6 inches by 1 foot 6 inches; under the top, between the legs, a back and sides are framed, and to the bottom of the sides two laths are fixed, so that a recess is thus formed that will take a half imperial board. The cases for diagrams are arranged for storing them in rolls, and are 6 feet by 2 feet 6 inches in the clear and 6 feet high, with a door of the full width and height at each end. There are two ordinary shelves in the height, and in addition nine open shelves, each formed of four oak laths 3 inches by $\frac{5}{8}$ inch, fixed to the styles of the framed sides.

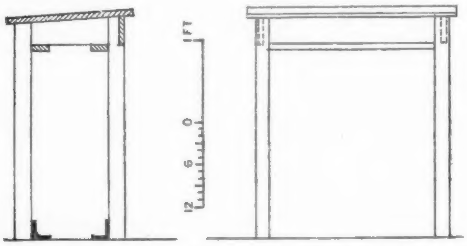


FIG. 4. STUDENTS' DESKS IN ENGINEERING LECTURE THEATRE, FIG. 2, C.

In the electrical department the fittings are almost entirely new. In the laboratory the work tables standing in the room are of a uniform size, the tops 6 feet by 2 feet 9 inches, to allow of combination if required. The work benches have tops of the same size, but are designed to stand against the walls, and have above the top a wooden skirting, and below the top each table has three deep drawers and three cupboards [fig. 5].

In the photometric gallery a railway is formed for moving the light to be tested; this is 22 feet long and is carried on fir bearers. The rails are 6 feet apart, and are formed of rails out of 8 inches by 2 inches, with 1 inch square ebonized mahogany strips glued and tongued on the upper edge, and the whole painted black. The distances representing candle-power up to 100 have since been calculated and painted on.

In the theatre the ordinary slate or blackboard has been replaced by one of plate glass, with a ground surface for drawing on, and backed with black cotton velvet. The lecturer's table in the electrical theatre is somewhat elaborate [fig. 6], and is specially arranged with a

view to easily controlling the various currents obtained from the cells. In addition to four cupboards, two of which contain all the terminals, and the nest of drawers under the top, the centre portion is left quite open, and at each end a broad recess 8 inches deep is formed,

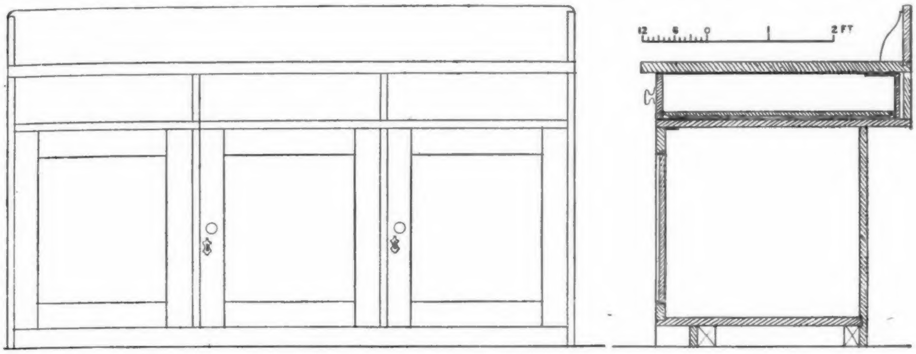


FIG. 5.—STUDENTS' WORKING BENCHES IN ELECTRICAL LABORATORY, FIG. 1, A.
The bench is arranged to stand against a wall, with space for hot-water pipes behind it.

and the cables from the accumulator-room, which is situated immediately below, are brought up and placed directly under the Professor's control.

The fittings of the physical laboratory are largely those already in use, or similar to them, and are slightly alluded to in Professor Carey Foster's Paper.

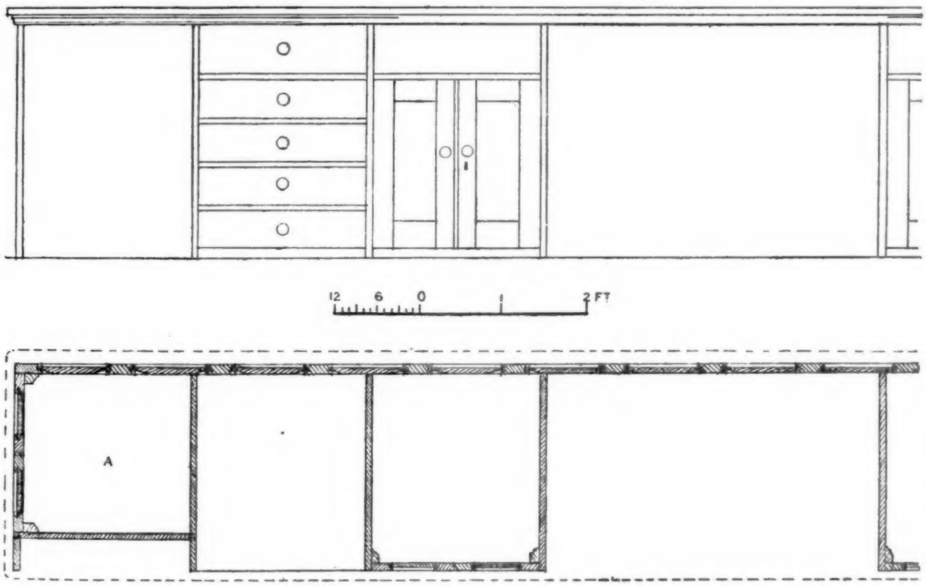


FIG. 6.—PLAN AND ELEVATION OF ONE HALF OF THE ELECTRICAL PROFESSOR'S LECTURE TABLE.
A, Cupboard receiving terminals; there is a similar cupboard at the opposite end.

In closing this account I should like to acknowledge the uniform and most valuable support and assistance rendered to me by the Chairman of the Building Committee, Sir Douglas Galton. Mr. Elsey Smith, though not nominally joint architect with me, was so

actually, and much of the detail of the undertaking was worked out by him. If, however, the buildings and fittings are adapted to their purpose, it is very largely due to the fact that, from first to last, we were in constant communication with the Professors who were actually working in the old quarters, and were to occupy the new. An architect so placed enjoys an advantage which when he is preparing competition designs from a printed programme drawn up by strangers is totally denied him, and I have in no instance in my practice been more sensible of the value of this sort of co-operation than in the present one, when I have worked in concert with my three colleagues, Professor Carey Foster, Professor Fleming, and Professor Beare, each of whom has kindly consented to give us some account of the special features of his own department. T. Roger Smith.

THE MECHANICAL ENGINEERING DEPARTMENT.

Mr. President and Gentlemen,—

Mechanical Engineering Laboratory and Workshop.—This is practically one large room 98 feet 7 inches long, and 50 feet wide, covered by a single span roof, and therefore having top as well as side lighting, the light being perfect. At the north end are four small rooms divided off by wooden and glass partitions, used for the following purposes: Professor's private room, office, cement testing room, and chemical or calorimeter room; while the south-west corner is separated from the main laboratory by a glass partition and forms the engine-room.

1. Cement Room.—This is fitted with two stone benches, on which the materials under test can be gauged, and afford space for six students to work at once; under these stone benches are shallow concrete tanks, in which specimens are placed for setting. There are also two strong wooden benches on which the rest of the apparatus in use is placed. The apparatus consists of forty moulds for tension and twelve for compression blocks, and all the usual gauging tools; also sets of sieves for fineness tests, and a testing machine of the standard German type with automatic shot run. It is intended to obtain Mr. Faija's apparatus for blowing test, and a few other small accessories, during the coming year. The following experiments are those usually carried out by students:—Tests for blowing, time of setting, fineness of grinding, weight, and the tensile and compressive strengths both of neat cement and of cement and sand. Regular series of tests are made to determine the laws of increase of strength of such briquettes with age, the value of fine grinding as shown in sand and cement tests, the proper proportion of water to be used, the effect on result of quickness of application of load, and, lastly, the relation of compressive and tensile strengths. All the tensile tests are made on the special machine, while the compressive tests are carried out on the large testing machine in the main laboratory. It is believed that by such a series of tests students acquire a thorough knowledge of the properties of cements and of the readiest means of ascertaining their quality.

2. Chemical Room.—This room is fitted with wooden benches, one of which, covered with a lead top, has a large lead sink fitted in it. The work carried out in this room falls under two heads: (A) Determination of calorific value of fuels; (B) Analysis of furnace and other waste gases. (*a*) *Calorific Value of Fuels.*—For this purpose a calorimeter is used in which combustion is supported by the use of a jet of pure oxygen. The calorimeter is of great accuracy, and is so constructed as to require very little correction for radiation losses; regular tests are made with it of the fuel used in all boiler trials, and of general samples of coal. (*b*) *Analysis of Furnace Gases.*—During all boiler trials samples of the waste gases are collected and volumetrically analysed in a simple fashion by absorption of the oxygen, carbonic acid, &c., thus enabling a complete heat account to be made out in any boiler trial.

3. **Main Laboratory.**— The equipment of this room consists of machine tools and the testing plant. The following machine tools are those which have been usually adopted for college purposes, and examples of all occur in the laboratory—namely, lathes, drilling machines, planing machine, shaping machine, and milling machine; there are also cutters, grinders, grindstones, and emery-wheels. All the specimens of the materials used in the laboratory for testing are prepared in these machines; in addition a good deal of apparatus is made for lecture and demonstrative purposes, and also models of machine parts and mechanisms. The tools are used rather for purposes of instruction than for the actual teaching of handicraft, which must necessarily be afterwards or previously acquired during an actual pupilage or apprenticeship in an engineering workshop; still, as the above work is mostly carried out by students, they acquire a considerable amount of skill in the use of the commoner machine tools. The main shafting is carried by brackets bolted to the wall of the building, and the countershafting by two long beams supported on cast iron **A** frames, power being supplied by a Crossley gas-engine of the latest type.

Testing Plant.—(1) Large testing machine made by Messrs. Greenwood & Batley, of Leeds. This is of the horizontal type, capable of exerting a maximum pull of 100,C00 lbs., and can be used for tension, compression, or bending tests. It is fitted with two pumps, the one for hand power used for small loads and for elastic tests, the other a power pump driven by the gas engine and used for heavier work. This latter pump does not deliver the water direct to the cylinder of the testing machine, but to an accumulator loaded to a pressure of one and a half ton per square inch. The water used in the test being drawn from this accumulator, an absolutely steady pressure on the ram of the testing machine is secured during any test free from all pump pulsations. All the valves are close to the hand wheel, which, by means of a pitch chain, runs the jockey weight out along the steelyard; the whole test is therefore under the control of one observer, the accumulator itself automatically throwing the pump belt off and on. The valves are also so arranged that if it is desired for any purpose, the accumulator can be cut off altogether, the pump then delivering straight to the cylinder of the testing machine. Extensometers are used with this machine for measuring the very small strains below the elastic limit; they mechanically exaggerate them 100 times, allowing an extension or compression of $\frac{1}{10000}$ of an inch to be measured. On this machine the students carry out elastic tests of all the materials commonly used by engineers; standard specimens are provided for the purpose, the same piece being subjected to each kind of strain; they are thus able to determine for themselves the values of the various coefficients of elasticity, and the relations which exist between them. They afterwards test to destruction similar specimens, generally prepared by themselves, making complete observations of the strains right up to the fracture point; all the data are afterwards plotted in the form of stress strain curves.

Among other experiments carried out on this machine which may be mentioned are series of tests to determine the laws for the variation of strength of struts with different proportions of length to diameter, and with different forms of ends; also another series to determine the best forms of cross sections of cast-iron beams; and the values of the ratio of the direct tensile strength of any material to its tensile strength as deduced from beam tests, or what Sir Benjamin Baker has called ϕ. On this machine also are carried out the compressive tests of cement and concrete cubes, of building stones, and of bricks and brick-work masses.

(2) *Smaller Machines.*—These machines were all made in the laboratory itself, and include a beam-testing machine for spans varying from 10 inches up to 50 inches, suitable for all small section beams, a torsion machine capable of testing up to $\frac{3}{4}$-inch diameter, and a special machine for long struts. These are all fitted with special exaggerating strain-

measuring gears, and experiments similar in outline to those on the large machine are carried out. Among the smaller plant in this room may be mentioned, apparatus for testing indicator springs, for determining the friction in pulley blocks and lifting tackle generally, and for falling-weight tests of beams. A special feature is the provision of two large drawing-tables at which the results of all the experiments may be at once worked out and plotted under the supervision of the laboratory demonstrators.

Engine Room.—In this room will be placed the experimental engine now being constructed by Messrs. Plenty of Newbury, and delivery of which is daily expected. The engine is of marine type, compound inverted vertical, the cylinders being 6 inches and 12 inches in diameter with a 12-inch stroke. It is completely jacketed throughout, and can be tested with all or any of the jackets not in use. The speed can be raised from 50 to 300 revolutions a minute, and it can be worked as a coupled or non-coupled compound, or either cylinder independently, and in every case either condensing or non-condensing.

It is fitted with a surface condenser, the air pump for which is worked by a small independent engine. Thermometers and pressure-gauges are fitted throughout, and by means of special thermometers the temperatures of the cylinder walls at varying depths will be determined. All the necessary calibrated tanks for collecting the air-pump discharge, jacket water, &c., are placed alongside, the condensing water being measured both by meters and by discharging it over a weir. By means of this engine the students can practically study the working of the steam engine in every possible way, and deduce for themselves the various empirical laws which have been laid down; it is also hoped that research work of a very valuable character will be carried out on it, on the important point of initial cylinder condensation. Steam is supplied by means of a 20 horse-power boiler situated in an annexe; this is of the loco type, and is completely fitted for thorough tests of its efficiency and for the determination of boiler losses and the best means of reducing them. Joint or separate engine and boiler trials can thus be carried out. It should be mentioned here that the gas engine which supplies power to the laboratory is also fitted up for tests of its thermodynamic and mechanical efficiency. For this purpose the cooling tank is shut off, and the cooling water drawn straight from the main through a Kennedy water-meter; from the jacket it escapes to the drain, the temperatures of inlet and outlet being measured. The gas passes through a Standard meter made by Messrs. Wright, and can be very accurately determined. It is intended to fit up an apparatus by which the volume of air used can be ascertained, and also the temperature of the exhaust gases; by this means a complete heat account of any trial could be made out.

Hydraulic Apparatus.—In the engine room are fitted up the various tanks for hydraulic experiments. These involve experiments on flow of water over weirs, through various orifices, through pipes and along open channels, the discharge from all being led into carefully calibrated tanks, enabling the students to verify for themselves the formulæ usually adopted in calculation on flow of water, or even to deduce formulæ for themselves.

In addition to the apparatus described, the following plant will be put up in this laboratory during 1894:—(*a*) Complete plant for testing lubricating oils, and for experiments on journal and pivot and screw friction; (*b*) Apparatus for testing gauges and indicators by means of a mercury column.

Woodworking Shop.—This is situated in the basement, but is well lighted, as owing to the natural slope of the ground it is only partly basement. It contains at present seven benches affording room for twenty-eight students at once, also two lathes, and complete stocks of the ordinary hand tools. Each student has a set of the most useful hand tools, and for these he is responsible; no work except that sanctioned by the instructor is carried out, and, as far as possible, it is made a progressive course of instruction in woodworking with special bearing on

Table 1.*—Report (dated June 28, 1892) on Crushing Tests of Four Yellow London Stock Bricks. All the Bricks had a Deep Frog on one side.

U.C.L. Test Number	Marks on Piece.	Dimensions. Breadth Ins.	Dimensions. Length Ins.	Dimensions. Area Sq. Ins.	Began to crack. Pounds. Sq. In.	Began to crack. Tons. Sq. Ft.	Breaking Load. Pounds. Sq. In.	Breaking Load. Tons. Sq. Ft.	—	—	—	—	REMARKS.
1418	...	4·22	9·05	38·19	2140	137·6	2205	141·8	...	...	...	...	Broke up completely, yellow, some cinder.
1419	...	4·23	9·17	38·79	1991	128·0	1991	128·0	...	...	...	...	Broke up completely, yellow, little cinder.
1420	...	4·19	9·00	37·71	1923	123·7	2781	178·8	...	...	...	...	Cracked only at one corner at max. load; further cracks developed, and gradually spread all through brick. On removal from machine, it broke up, colour yellow, little cinder.
1421	...	4·15	9·05	37·56	2309	148·5	2309	148·5	...	...	...	...	Much darker in colour, much cinder, friable, broke up completely.
				Means	2091	134·4	2321	149·3					

Note.—All were prepared for testing by putting a thin layer of Plaster of Paris on opposite faces, and paring these smooth and parallel.

Table 2.—Report (dated July 28, 1892) on Crushing Tests of Four Fletton Bricks received from Messrs. A. Bush & Son.

U.C.L. Test Number	Marks on Piece.	Breadth Ins.	Length Ins.	Area Sq. Ins.	Began to crack. Pounds. Sq. In.	Began to crack. Tons. Sq. Ft.	Breaking Load. Pounds. Sq. In.	Breaking Load. Tons. Sq. Ft.					Remarks
1518	Moulded L.B.C.	4·16	8·84	36·78	1370	88·1	1935	124·4	...	...	...	...	Broke up completely. Reddish-brown at outside. Blacker towards centre.
1519	do.	4·12	8·82	36·34	2201	141·5	2514	161·6	...	...	...	...	ditto ditto
1520	Marked by stencil mark Fletton Brick Co., 16 Holborn Via. P	4·12	8·38	34·52	2234	143·6	3059	196·6	...	...	...	...	ditto ditto
1521	do. W	4·20	8·82	37·94	2227	143·2	2767	177·8	...	...	...	...	ditto, but of a much redder tint throughout.
				Means	2008	129·1	2569	165·1					

Note.—All were prepared for testing by putting a thin layer of Plaster of Paris on opposite faces, and paring them smooth and parallel.

Table 3.—Report (dated September 8, 1892) on Crushing Tests of Two Specimens of Portland Stone, 2¼″ Cubes, received from Messrs. Bush & Son.

		Dimensions. Breadth. Ins.	Dimensions. Breadth. Ins.	Dimensions. Area. Sq. Ins.	Height of Cube.		Crushing Load. Lbs. per Sq. In.	Crushing Load. Tons per Sq. In.	Crushing Load. Tons per Sq. Ft.		Density compared with Water.	Mean weight of 1 c. ft. in lbs.	
1525	13·5·92 C.W.M. Brown Portland	2·23	2·23	4·98	2·23	...	6650	2·97	427·4	...	2·20	137·6	Broke quite fairly.
1526	do.	2·23	2·25	5·00	2·21	...	6336	2·83	407·2	...	2·20		
							6493	2·90	417·3				

Table 4.—Report on Tensile and other Tests of a Sample of Portland Cement received from Messrs. A. Bush & Son.

							Breaking Load in Lbs. per Sq. In.		Fineness. Percentages retained on a 50 mesh	Fineness. Percentages retained on a 75 mesh		
1517	...	Mean of six tests Age 7 days			...	...	452·1	...	14·0	22·0	...	Time of setting 100 minutes. Some very small *air-holes.*

Table 5.—Report (dated September 8, 1892) on Crushing Tests of Three Portland Cement Concrete Blocks received from Messrs. A. Bush & Son.

		Dimensions. Breadth. Ins.	Dimensions. Breadth. Ins.	Dimensions. Area. Sq. Ins.	Began to crack. Pounds. Sq. Ins.	Began to crack. Tons. Sq. Ft.	Breaking Load. Pounds. Sq. Ins.	Breaking Load. Tons. Sq. Ft.					
1522	1	3·28	7·60	24·9	1735	111·5	1944	125·0	...	...	...	...	Broke quite fairly, good sound concrete, apparently gravel and cement.
1523	2	3·45	7·15	24·7	1134	72·9	1237	79·5	...	...	...	...	Broke quite fairly, good sound mixture, apparently loam and cement.
1524	3	4·02	7·32	29·4	1102	70·8	1147	73·7	...	...	...	...	Broke quite fairly, good sound mixture, apparently loamy gravel and cement.
				Means	1324	85·1	1443	92·7					

Note.—All were tested, prepared as in case of bricks, by putting thin layers of plaster of Paris on opposite faces.

* See reference to Tables on p. 294.

the lecture-work. It is intended to provide in addition to the present tools a saw-bench and band-saw machine, and to put up some shafting, power to be supplied by a small electric motor worked off the current supplied by the Vestry.

Forge.—This is also in the basement, next the boiler house, and contains a convenient-sized forge, anvil, and all the usual smith's tools. It is almost entirely used for work in connection with the making of laboratory apparatus and for tool-making.

Drawing Office.—Occupies whole of upper floor; each student is provided with a separate drawing-table fitted with lock-up drawer. There are one hundred of these. This room is open for work all day, instruction being given during the afternoons.

Lecture Theatre, Museum, &c.—The former provides seating accommodation for sixty students, each one having a small table supplied with drawing-board and T-square; demonstrations can thus, if necessary, be given, during which the students draw accurately to scale the diagrams and constructions worked out on the black-board by the lecturer. The lecture-table has gas and water laid on for experimental purposes. Behind the theatre is a room for the preparation of experiments, and for the storage of models, lecture apparatus and diagrams, and also a dark room for photographic work. The museum forms an ante-room to the lecture theatre; it has wall-cases all round in which are exhibited models of important mechanism, of various link works, valve gears, machine parts, &c., and two centre show cases for the exhibition of typical fractured specimens of instruments such as indicators, integrators, &c., of specimens of engineering materials, and of various electric cables, insulators, &c.

It may be mentioned here that during the erection of the building, tests were made in these laboratories of the various materials used by the contractors; the details of these tests are given in Tables 1 to 5 [p. 293]. The general results are as follows:—

Table 1.—Crushing Tests of 4 London Stock Bricks
Began to crack at a load of 134·4 tons per sq. foot.
Crushed up „ „ 149·3 „ „ „

Table 2.—Crushing Tests of 4 Fletton Bricks
Began to crack at a load of 129·1 tons per sq. foot
Crushed up „ „ 165·1 „ „ „

Table 3.—Crushing Tests of two $2\frac{1}{4}''$ cubes of Portland stone
Crushing load . . . . 417·3 tons per sq. foot

Table 4.—Tensile tests of Portland cement
Strength after 7 days 452·1 lbs. per sq. inch

Table 5.—Crushing Tests of 3 Portland cement concrete blocks: Mean crushing strength 92·7 tons per sq. foot.

T. Hudson Beare.

THE ELECTRICAL ENGINEERING DEPARTMENT.

Mr. President and Gentlemen,—

THE portion of the new buildings allotted for the purpose of teaching electrical engineering consists of six rooms, in all of which the interior arrangements have been carefully designed for this purpose. The four principal rooms open into one another. These are the dynamo-room, the lecture theatre, the apparatus-room, and the electrical laboratory. The general arrangement of the building permitted the dynamo-room floor to be placed on solid ground, and thus secured the possibility of making both floor and machine foundations of great steadiness. This dynamo-room is 31 feet long and 22 feet wide, built in white glazed brick. The plant placed in the dynamo-room consists in the first place of a nine horse-power nominal Otto-Crossley gas engine, capable of working up to 19 indicated horse-power. This engine is fitted with all the most recent improvements. It is bedded on a slab of Yorkshire stone resting on the concrete foundation floor, 24 inches in thickness, which is carried over the whole room. In this concrete floor all the pipe trenches are formed, and these last are lined with brick and covered with the usual cast-iron chequer plates. The engine is provided with the latest pattern of self-starting arrangement adopted by Messrs. Crossley Brothers. This contrivance consists simply of a massive cast-iron chamber, into which a charge of gas and air is pumped by an auxiliary hand-pump. If the

engine is stopped, so that the crank is on the middle of the top stroke, it suffices to fire the compressed charge at a touch-hole to start the engine even under full load. This arrangement is as simple as it is effective, and not the slightest difficulty has ever been experienced in starting the engine with it. The engine is provided with two very massive flywheels, to secure steady running, and the crank shaft carries outside the left-hand wheel a Mather and Platt clutch pulley 60 inches in diameter, and on the right-hand side a 36-inch pulley for driving on to a counter-shaft. From the Mather and Platt clutch pulley is driven by a belt a Crompton continuous current six unit dynamo, which is employed exclusively for charging the secondary battery. This clutch pulley permits the charging dynamo to be thrown into and out of action whilst the engine is running. The engine is provided with a double service of cylinder cooling water: one service being brought from two wrought-iron tanks placed on an elevated platform in one corner of the engine-room, and the other service comes direct from the water supply mains of the building, and is taken through a water meter. The water circulating through the cylinder jacket from the continuous supply is carried away by a funnel into the main drain. The temperature of the in-coming and out-going water can be taken with thermometers, and the quantity of water which circulates is registered by the meter. Hence the number of units of heat removed from the cylinder becomes known. The gas for the engine is taken direct from the street mains, through a separate gas meter. The indicating gear fixed to the engine operates a new form of high-speed indicator by Elliott Brothers, which gives a particularly good card on gas engines. It will be thus seen, then, that all arrangements have been provided for making a technical study of the gas engine itself as a prime motor.

The whole of the gas engine plant and engine work has been supplied by Messrs. Crossley Brothers, of London and Manchester, who have carried out the work entrusted to them in the best possible manner in accordance with the designs of the Professor of Electrical Engineering. Against one wall of the dynamo-room is fixed a series of cast-iron brackets, which carry a two-inch steel counter-shaft. This counter-shaft is driven by a belt from the right-hand drum of the engine, at a speed of 280 revolutions per minute. This counter-shaft carries a fast and loose driving-pulley with belt shifting gear. The shaft is cut in the centre and provided with a clutch-gear and two driving-pulleys, one on each side of the clutch. These pulleys are connected by belts with the two pulleys of a Kummer dead weight transmission dynamometer, placed on the floor in line with them. When this clutch is open and the gas engine is driving on to one half of the counter-shaft from the drum, the other half of the counter-shaft can be driven either direct or through the transmission dynamometer, and a measurement made of the power thus being given to that half of the shaft, and from which any dynamo or dynamos may be driven. The counter-shaft is supported upon ball-bearings which are carried on wrought-iron brackets built into the 14-inch wall set in cement which carries them.

Returning, then, to the construction of the dynamo-room floor, it has already been mentioned that this consists of a concrete floor 24 inches in thickness. This concrete is finished 2 inches from the wall all round the room, and slag wool packed into the interspace. On the concrete are laid, 18 inches apart, teak beams 6 inches deep by 4 inches wide. These beams are held down by 24-inch holding-down bolts, which pass right through the concrete, and are terminated in anchor plates at the bottom. The space between the beams is then filled in with granolithic cement. The cement is cupped out between the beams, and given a slight cant towards a main drain running down the room formed in the cement. By this means oil or water spilt on the floor is easily got rid of and the floor kept dry. The floor has proved itself to be so satisfactory that no sensible vibration is propagated up the building when the engines and dynamos are at work; and delicate electrical instruments can be used in the

room when the engine is in operation. The silencing-chamber of the gas engine is placed in a pit in one corner of the room, and is air-jacketed to keep the temperature of the room down. The engine discharges into an exhaust pipe carried up a brick chase in one corner of the room, and then through the roof.

Turning next to the dynamo-plant, this consists, in the first place, of a Crompton continuous current dynamo, giving an output of 45 amperes at 140 volts. This dynamo is driven direct from the Mather and Platt pulley of the dynamo. The duty of this dynamo is to provide the charging current of the secondary battery. The electromotive force of this machine is regulated by a variable resistance placed in the circuit of its field magnets, whilst an automatic cut-out is placed in the main circuit to prevent the charge of the cells from coming back into the dynamo. In addition to this dynamo, the room contains a very useful and excellently designed motor-alternator plant, by Messrs. Johnson and Phillips. This machine consists of four independent dynamos bolted down on to one common cast-iron bed-plate 10 feet in length. Each half of the machine comprises a direct current motor, which is directly coupled to a Kapp alternator, each dynamo being of 5 horse-power, or capable of an output of 3,500 watts. Each coupled motor-alternator has a pulley with a flange on it, and the machines are so set on the bed-plate that the pulley flanges are in close contiguity with each other, but do not quite touch. The flanges can, if need be, be coupled by two bolts so as to unite the two halves of the shaft into one, and make all four dynamos drive together as one machine. With this compound motor alternator it is possible to carry out an immense range of instructional work. Thus, either motor can be driven by the current from the secondary batteries, and will drive its own coupled alternator. Hence, by properly exciting the fields of the motor and alternator, an alternating current is furnished by the alternator of any required frequency and electromotive force within certain limits. The two halves of the plant can be driven together or separately, and the alternating currents delivered by the alternators may be put in any relative difference of phase by properly uniting the pulley flanges with the coupling bolts. As an illustration of the work which may be done with this plant in teaching, besides employing it for the generation of either continuous or alternating currents, we may point out that the following experimental work can be carried out.

1. Either plant may be run separately by a belt from pulleys on the counter-shaft, and will produce from the alternator an alternating current of 100 volts or 150 volts, according as the fields are arranged, the current being 35 amperes, and from the continuous current machines a continuous current of 35 amperes and 100 volts or less.

2. By coupling the shafts rigidly together they may be run as one plant, and either the currents or potentials of the two similar machines added together, thus giving continuous or alternating currents of 35 amperes at 200 volts, or 70 amperes at 100 volts.

3. Either of the continuous current machines can be run as a motor by current from the secondary battery, which is charged by the Crompton dynamo. By regulating resistances the speed may be regulated within wide limits. In this way alternating currents of various frequencies can be drawn off from the alternators either separately or running as one machine.

4. The two separate plants may be coupled together by the bolts through the respective pulley flanges, so that the alternating currents given by the two alternators are in any relative phase. They may be coupled together so as to give the effect of a two-phase generator, with the alternating currents 90° different in phase.

5. Efficiency tests can be made on the combination either of continuous and alternating current machines or of two similar machines.

6. The alternators can be run in parallel, each being driven by its own separate motor, and the conditions of parallel working thus explored.

In addition to these dynamos there is also a small $\frac{1}{2}$ horse-power continuous current Crompton dynamo, a 2 horse-power Westinghouse alternator, and a small Stanley direct current motor for experimental purposes. On a spare set of slide rails any dynamo can be bolted down for test, and driven from the counter-shaft or by a continuous current motor. It will thus be seen that the dynamo-room is provided with plant for teaching thoroughly and practically the testing of dynamos. The walls of the dynamo-room are occupied with the switches and resistances for operating these dynamos and motors. There is, in the first place, a resistance frame which acts as a standard power absorber. This consists of eighty wires of Hadfield's manganese-steel each 25 feet long, stretched up and down one side of the room over porcelain insulators. The wires can be joined in parallel as required by a set of special switches. When so arranged, their resistance is capable of dissipating a power of 8,000 watts, or about 11 horse-power. This is used for taking up the power of dynamo machines under test. Other resistances are provided for starting the continuous current motors, for varying the fields of the alternators and continuous current machines. The dynamo-room is well lit by a skylight roof, warmed by hot-water pipes, and provided with gas, water, and electric incandescent lighting. A small vice-bench under the window enables all small repairs to be done on the spot.

The dynamo-room opens into the lecture theatre, which is 32 feet wide and 35 feet long. On a platform is placed a lecture table, 20 feet in length. To the back of this platform are brought the electric mains from the dynamo-room. These are laid in covered chases on the floor, and all this cable work has been carried out with the highest quality of india-rubber covered cable laid in white wood casing, and no joints are made in any position under the floors. The cables from the dynamo-room conducting the current from the various machines all terminate in lock-up cupboards at each end of the lecture table, and thence proceed to a main switch-board at the back of the lecture table.

The battery charging current from the Crompton dynamo is brought through an ammeter and voltmeter to a main battery switch-board, and thence it is distributed to the secondary battery in the room beneath. From this switch-board a main runs all round the laboratories, distributing at various points as required continuous current at a pressure of 100 volts. The currents from the two alternators are brought to the lecture table, one to one end and the other to the other. Experiments with two-phase currents can thus be shown. The arrangements for charging and discharging the secondary battery are conveniently to hand, and the instruments show at a glance what current is going into the battery and what is coming out of it. In front of the lecture table is a raised gallery of seats capable of seating sixty students. At the back of this gallery, in a space 8 feet wide under the windows, is a long work-bench fitted with vices, at which instrument making and other similar metal- and wood-work is carried out. The lecture-room is well lighted by pendant incandescent electric lamps, and the switch-board for controlling the supply of the lighting current, which comes from the St. Pancras Electric Lighting Station, is placed at the back of the lecture table.

At the end of the lecture table is a specially designed vertical electric lantern, for projection work. This is operated by a Brokie arc lamp with inclined carbons. The arrangement has been so worked out that not only lantern slides but any apparatus capable of projection can be immediately shown on a 10-foot screen by simply switching on the arc lamp. The lecture-room can be darkened in a few seconds by pulling up dark blinds over the three windows which light the room. These blinds are pulled up by cords, which are brought over the ceiling to the back of the lecture table. Every arrangement has been made for quickly and readily enabling any experiment to be shown which requires the optical lantern to exhibit

it. At the sides of the room and at the back of the lecture table are suitable screens for carrying diagrams and plans.

The electrical laboratory opens out of the lecture-room. This is a room 50 feet long and 32 feet wide. In order to secure quietness and to keep out the dust, the room has been built with double windows, the outer ones being ordinary sashes, and the inner ones French windows. Black blinds are provided, so as to darken each window when required. All round the room a series of stout stone slabs are let into the wall at a height of 4 feet above the floor, between the windows. These stone slabs are intended as steady tables to carry various measuring instruments. It is found by experience that it is better to arrange the steady tables in this way than to build them up as brick pedestals through the floor of the room, because advantage is then taken of the greater steadiness of the footings of the main walls, and the central portion of the room is kept clear. Across and around the floor of the laboratory chases are left, covered in by floor boards, in which electrical mains are carried, and these terminate in lock-up switch and fuze boxes in various parts of the room. At one end of the laboratory is a long photometric gallery, 30 feet long, 10 feet high, and 6 feet wide. In this gallery is placed the photometer and various apparatus required in testing arc and incandescent lamps. One end of this gallery is formed into a small dark room for photographic purposes.

Around the room are placed a series of strong tables having drawers and cupboards, and each of these tables is provided with electric currents from the mains, and with a special circuit for working the incandescent lamps required by the galvanometers. In the centre of this room numerous other tables are arranged for special work. On the stone steady slabs are placed all the standard electrical instruments, and the general principle has been adopted of having each particular piece of apparatus required for each special electrical measurement set up and arranged so that it is never disturbed, and is always ready at a moment's notice for use and experiments. One side of the room is devoted to the current weighing instruments and standard voltmeters. The laboratory is provided with a very fine set of Lord Kelvin's standard electrical balances and electrostatic voltmeters. These balances are checked by weighing the copper deposit produced in a voltmeter in circuit with them, and for this purpose an Œrtling chemical balance has been specially built, and which is a remarkably fine instrument. On other tables are set up the apparatus for the measurement of resistances, insulation tests, magnetic induction, electrical capacity and potential, and as these permanent pieces of apparatus are never disturbed, a great economy of time is effected in setting up and taking down apparatus. In addition to the above, the experimental apparatus is provided for complete tests of alternating current transformers and other alternating current appliances.

Beneath the lecture-room is a large accumulator-room built in white glazed brick. On stone shelves round the room are placed fifty-four cells of a Crompton-Howell battery. This battery has a storage capacity of 200 ampere-hours, and will discharge at the rate of 100 amperes. The current from the battery is laid on to all the working benches of the laboratory.

It will thus be seen that every facility has been provided for giving instruction in electro-technical work and also for original research. Although other laboratories may be larger in room space, few are better provided with the appliances for research, and the great care with which all the details have been considered has resulted in providing the most convenient and expeditious methods of carrying out the work intended to be done in the laboratory.

The general plan of the laboratory, of having all the rooms opening one into another, is an immense convenience, and saves much time. The arrangement of apparatus in permanent groups for special measurement effects also a great economy in time, as apparatus once set up

is not unnecessarily disturbed. The care with which the heating and ventilation have been considered, as well as the universal adoption of the electric light, has made these laboratories exceedingly comfortable to work in. The rooms are all excellently lighted. Although the laboratory stands in a main street, yet no difficulty has yet been found to arise from vibration. The stone steady shelves let into the main walls provide all that is necessary in the way of support for the instruments which must be kept steady.

Besides the above rooms, a diagram- and model-room, apparatus-room, and professor's private room are included. The apparatus-room opens into the lecture-room close to the lecture table. The apparatus-room is well provided with dust-tight apparatus cases and cupboards for the laboratory apparatus. Access is obtained to the accumulator-room when required by a cellar-flap door opening out of the lecture-room, and through this opening any cells can be hoisted up or let down which are required for examination.

In the arrangement of electric mains and in the installation of the electric lighting work only the highest class of material was allowed to be employed. The electric lighting work has been admirably carried out by Messrs. Belshaw & Co., under the specification of the Professor of Electrical Engineering; the gas engine and engineering work generally by Messrs. Crossley Bros.; the accumulator and dynamo plants by Messrs. Crompton & Co.; and the motor-alternator plant by Messrs. Johnson & Phillips.

The electrical fittings, switch-boards, fuzes, switches, casing, wire, and other accessories were supplied by the Edison-Swan United Electric Light Company and the General Electric Company, and no expense has been spared to make the equipment of the laboratory as complete as possible, and to place University College, London, as far as possible in the front rank in the provision of means for teaching the principles of the important subject of electrical engineering.

J. A. Fleming.

THE PHYSICAL DEPARTMENT.

Mr. President and Gentlemen,—

IN order to explain the purposes that had to be kept in view in dealing with the space allotted to this Department, it will be well to give a short outline of the courses of instruction in Physics at present given in the College, so as to indicate the various wants that had to be provided for.

From our present point of view these courses may be conveniently divided into those which are carried on in the lecture-room and those carried on in the laboratory. The former consist of (1) two courses of lectures on Theoretical Mechanics, one very elementary and the other rather more advanced, both with experimental illustrations; (2) a general course of (about ninety-five) experimental lectures on the main branches of Physics, including Heat, Electricity, Magnetism, Light, and Sound; (3) a more advanced course (of about 140 lectures) on the same subjects (this course is mainly mathematical, but in part also experimental); (3) a short course, given twice in the year, of about twenty experimental lectures specially intended for medical students. In all, some twelve or fourteen lecture-room classes are held every week. To accommodate these, two lecture-rooms are provided. They are marked in the plan "Lecture Theatre" and "Class Room" respectively [page 286]. The former is seated for about eighty students, and the latter for about forty-five. Both these rooms can be readily darkened for showing optical experiments or for lantern demonstrations. In the larger room a space about seven feet square on the wall behind the lecture table is painted a dead white to serve as a lantern-screen. In this room also an oxyhydrogen light or an electric-arc light can be used whenever either is wanted, and electric currents up to thirty amperes

can be drawn from a secondary battery of forty-four large cells. In both rooms the lecture tables are, of course, supplied with gas and water.

On the same floor as the lecture-rooms, and opening directly out of the principal one, is the Apparatus Room, fitted with seven large glass cases for keeping the apparatus used at lectures. Although there are two doors into this room, it is not intended that it should ever be made a thoroughfare. A storeroom is provided for keeping such necessary matters as can be more properly classed as material than as apparatus. There is also a small chemical laboratory, where the operations frequently required in order to prepare substances for experiment can be carried on out of the way of the physical instruments.

The laboratory instruction is of two kinds—first, class-work for elementary students; secondly, the individual work of those who are more advanced. The basement of the central wing of the main building is principally devoted to the more elementary laboratory-work, and a separate building, measuring about eighty-five feet by thirty-two, is used as the senior laboratory. This is connected with the main building by a glazed covered way.

At present, all students of the general elementary course of Experimental Physics are expected, besides attending three lectures a week during the College Session, to attend one hour a week for working numerical exercises on the subjects of the lectures, and an hour and a half for practical laboratory work. For this last part of the work the class is divided into three divisions, the members of which attend on specified days in the room marked "General Laboratory" on the Basement plan [p. 286]. This room is arranged with sixteen working places for two students each, each working place affording table-room measuring 6 feet by 2 feet 9 inches, and being supplied with gas. Water is laid on at two sinks, but not at the working tables.

There is room for thirty-two students to work together, but I have not yet ventured to have more than twenty-four at once. This number, working two together, all make the same experiments at once. These experiments consist almost exclusively of simple measuring operations, and it has been needful in some cases to devise special forms of apparatus capable of being multiplied sufficiently to supply the whole class at a moderate cost.

With regard to the fittings and general arrangements of the room, there is very little to say, these having been kept as simple as possible. Almost the only thing calling for remark is the way in which the tables are supported on sleeper-walls capped with flat stone slabs, 12 inches wide and 6 feet from centre to centre, as has been already described in the account of the buildings. The tables are of deal, stoutly made, and stiffened by diagonal braces between the legs. They measure 6 feet by 2 feet 9 inches, and are 3 feet high. They stride across from one sleeper-wall to the next, two feet being on each. They are thus solidly supported, and afford all the steadiness requisite for ordinary operations.

Another room in the basement is arranged as a Junior Electrical Laboratory, and at present it will probably be chiefly used for a course of instruction in Electrical Measurements, intended specially for students who are afterwards to enter Professor Fleming's courses of Electrical Engineering.

The advanced laboratory consists of four rooms, two of them measuring 32 feet 9 inches by 30 feet 9 inches, and the others 24 feet by 16 feet. These are contained in a separate building, which is so planned that, if at any future time it is found desirable, it can be divided into a series of five rooms on the ground floor, each measuring 24 feet by 16 feet, and one room of the same size above; or the upper floor can, if needful, be extended over the whole.

Here, again, there is but little to mention in the way of special fittings. Everything has been purposely kept as simple as possible; for in the case of a science that is advancing so

rapidly as Physics, and the educational requirements of which are undergoing such rapid development, any complicated arrangements planned for special purposes are liable before very long to drop out of use, and are then more likely to prove impediments than helps. Gas and water must be at hand, and above all things steady supports are essential. In respect of this last requirement, the situation of the laboratory, near the south-east boundary of the College ground, is decidedly favourable.

There is no heavy traffic within a considerable distance of the buildings, and, for a site in the heart of London, the soil is fairly free from tremors. The special precautions taken with a view to steadiness are as follows:—The floor is formed of wooden blocks laid directly on a bed of concrete 6 inches thick; stone slabs project from the walls in various places to serve as supports for instruments; short wooden beams are built into the walls near the roof, and serve as firm points of support for anything that has to be suspended from above; lastly, breeze bricks are let into the (unplastered) walls at intervals, both horizontally and vertically, of 2 feet from centre to centre. These bricks will hold nails and screws as firmly as wood, and by means of them a firm attachment to the wall can be obtained at any time without plugging or risk of loosening the brick-work.

The rooms in the main building are lighted throughout by incandescent electric lamps, the current being obtained from the St. Pancras Parish mains. G. Carey Foster.

DISCUSSION OF THE FOREGOING PAPERS.

Mr. P. GORDON SMITH [*F.*] said, without attempting to discuss the details of the Papers they had listened to, he could not but admire the skill with which Professor Roger Smith had concentrated so much useful accommodation on so confined a site. He had succeeded, he thought, in producing a splendid set of laboratory offices. Professor Roger Smith had expressed his own conviction that a flat floor for a lecture theatre was not altogether the best, but that his colleagues in the undertaking preferred it. He (the speaker) had no doubt they had got just the right arrangement; but he could not help sympathising with what the Professor felt, namely, that for demonstrations at a lecture table, the conditions, perhaps old-fashioned, seemed to point to an arrangement by which the audience would be raised so that they might have a better view of what was going on at the table; and he should like to hear the views of the Professors bearing upon that point. On behalf of the Science Standing Committee, of which he had the honour to be Chairman, he would propose a vote of thanks to Professor Roger Smith for his valuable Paper, and also to Professors Beare, Fleming, and Carey Foster for their appended Papers. The material which had been placed on record in the Journal would, he was sure, be of extreme value to many architects who would be called upon from time to time to design the various technical schools and centres of education which were being promoted throughout the country.

Professor KERR [*F.*] seconded the vote of thanks, and said that the Paper which had been read, and the illustrations which accompanied it, showed in a very striking manner what had to be done in the way of complicated arrangements by architects nowadays under special circumstances. Professor Roger Smith and his distinguished colleagues had to all appearance produced an exceedingly complete and serviceable design in every respect. From what he knew of some of them personally, and of the others by name, he should have expected that they would have accomplished that result—he would not say with ease, because it was no easy matter—but certainly with such facility as attached to scientific work done *secundum artem*. To follow out anything like a discussion of the details of the arrangement was, as Mr. Gordon Smith had said, impossible. But they, as architects, must see that this was but one of many illustrations of the necessity for carefully considering the internal economy of their buildings. Some of them were old enough to remember the time when buildings of the kind described would have been designed in a very classical manner, and constructed in a very substantial manner, and the Professors of the several departments would then have been allowed to settle down in them, and to do as they best could. But that state of things was no longer tolerable, and he presumed that Professor Roger Smith's colleagues had personally been allowed to instruct the architect in all the minutiæ of their paraphernalia, and that he had to accommodate himself to the requirements for those minutiæ without any excuse for aberration or shortcoming. With regard to architecture nowadays in its practical form, they must all of them remember, and especially the young men, that the public in a practical country like theirs,

and fast becoming more than practical by the absolute necessities of science, art, and other considerations, would require an architecture of the utmost possible skill as regards internal organisation. He thought, therefore, that the illustration which had been afforded them of the painstaking care with which the organisation had been accomplished was a most important thing; and although probably they would not be able to conduct a lengthened discussion upon such a subject, yet he hoped they would hear some observations from Professor Carey Foster and others skilled in such matters, so as to encourage architects in putting their shoulders to the wheel to assist them when occasion required in producing absolutely perfect results in respect of the internal organisation of buildings.

Professor Unwin, F.R.S. [*H.A.*], said that the exceedingly modest and interesting Papers which had been read, relating to so very necessary and important a work, were so explicit that they did not invite much discussion. One could not but congratulate University College that, having been in past times, as was often quite justifiably said, the pioneer in some branches of scientific education, it had now brought its engineering school and equipment up to a level with some other more modern institutions which had grown up in the last dozen years. For the first time in this country there was established an engineering laboratory in connection with the engineering school, and it was a very meritorious achievement. It might, perhaps, be of use, by way of comparison with the figures given of the space required by the laboratory of an engineering school, to shortly give two or three figures from the Central Technical College in Kensington. They had there altogether two hundred students, but they were divided into three distinct divisions, and he supposed in the engineering department by itself they had not more than eighty regular students—about the same number as University College. They had there an area for the carpenter's shop of about 1,000 square feet; for the workshop, laboratory, and boiler-room they had altogether 7,000 square feet; for the drawing office about 2,400; for the class-rooms a little over 1,500; and for the lecture theatre, in addition to that, about 1,500 square feet. Those were rather larger areas than at University College, but not greatly so—the electrical department there, he supposed, occupied at least as large a space, and probably larger. It was almost a defect, he thought, that, in regard to the equipment of engineering schools, the laboratories were getting almost too much of an identical form; it would have been almost preferable if in different laboratories certain special directions of plan had been a little more specialised. In the engineering laboratory design he did not note anything which was not very much in common with almost every modern engineering laboratory. But there was one point raised in the Papers on which, as it dealt with the equipment of an engineering school, he might say a word. In the arrangement of the equipment of the school at University College he thought the workshop took rather too subordinate a place. He had been teaching engineering now for twenty-five years, and he supposed that twenty-five years ago no one was less favourable than he was to the attachment to the engineering school, not, indeed, of a laboratory, but of a workshop. Experience during those years had taught him that the workshop was a very important part of any modern engineering school; and in coming to that view he believed he was in accord with the universal experience in America, where the schools, on the whole, were very much better equipped than in England, and where, universally, the workshop in the college took an important place. In the first engineering school in which he had taught the students were six months in the dockyard workshops and six months in the scientific school, and a better arrangement than that it was hardly possible to imagine; but it was not an arrangement which it was practicable to adopt in ordinary cases. If they had not that sandwich arrangement of work and scientific instruction, then they must do one of two things: the workshop must be taken before they come to college, or they must go to the workshop after having been at college, unless there was a workshop at the college. If the work was taken before coming to college, his experience was that the student who had been for some three years doing practical work in engineering had so lost the habit of study—the kind of study, he meant, necessary to college—had so lost the power of application in mathematics, that they could never do with him what they would like to do with any good student; he had got rusty in the kind of work which went on in college. If the workshop, therefore, was not taken first, and if a lad came straight from school to college, and if they gave him no practice with tools, a great deal of the engineering instruction went over his head. At the Central Technical College a definite regular course of workshop instruction was given; they did not give a very large amount of time to it—he did not think, on the whole, it amounted to more than four and a half hours per week—but he did find that, with that limited amount of instruction, the lads got ideas and the power of understanding the meaning of the lecturer, which they did not get in any other way. He therefore attached a great deal of importance to the workshop. Professor Beare had told them in his Paper that the lads in his laboratory did use the tools, apparently in preparing specimens for testing, and so on. That was good, so far as it went. He did not pretend to any infallibility in the matter, but his own experience rather led him to think

that that kind of work was not particularly instructive; that if they were going to use the workshop in the college, and not to give up more time than they could well afford to workshop instruction, then the workshop should be a course by itself—that it should follow a more methodical and graduated arrangement, and that the preparation for testing should be left to the ordinary workman—it was rather too monotonous for the ordinary student. However, he was merely expressing his individual opinion for what it was worth, after some years of technical teaching. He congratulated University College very much indeed that, having begun with a laboratory, it had now proceeded to enlarge and improve its laboratory until it had got so good a one.

Mr. H. H. STATHAM [*F.*] said that theirs was an architectural society, and he thought the evening ought not to pass over without something being said from the architectural point of view also. It seemed to be entirely forgotten that the Professors of University College were in possession of a building, by an eminent architect, which was one of the ornaments of London. They had heard no reference whatever made to what was the original design for that building, or as to the extent to which that design had been considered, except the one remark that the internal ordinance of the quadrangle had been carried out. But he did not believe that Wilkins ever intended that internal ordinance to be carried round the Gower Street side at all. He had challenged the Professors of University College to produce evidence of it, and he had got no answer; but there was in the library of the Institute a small old-fashioned engraving which was marked as the "Design accepted by the Committee "of University College," and although it was a very poor little thing, as they now called architectural drawings, he thought it easy to see what was Wilkins's intention from that drawing with regard to the building. The two side wings, the North and South Wings, were ultimately to be brought up to the street; they were to be connected by a low ambulatory of one storey—that was omitted from the drawing for the sake of clearness, but it could be seen by the plan what was meant—and the fronts of the street were not to be treated with flat pilasters like those shown in the drawing, which were even flatter in execution than there illustrated; the front was to be broken, the centre part brought out, and the upper portion to be a portico of four columns, standing free. It would appear, then, obvious to every architect that Wilkins's idea was that those porticoes were to be a kind of echo or balance of the centre portico. He was not so bigoted as to say that, when the College wanted more room inevitably for their workshops, they were not to consider that first; no doubt they were bound to do so; but he thought a little more attempt might have been made to carry out what he conceived to have been Wilkins's design, and that, at all events, they might have heard some reference to that point, and some regret that it should have been necessary to spoil the work of an eminent architect, and to deprive that part of London, which had few attractions, of one of its beauties, and of an open space which they could ill spare. He confessed he should have felt a little more kindly towards the College authorities if they had been more straightforward in the matter. On the day when the laboratories were opened, his old acquaintance Mr. Horsburgh, the Secretary, told all the reporters that it was quite wrong to suppose that they were going to close the quadrangle or blot out the dome—that there would be a space of 100 feet in the centre. As several of the Professors of the College were present at that Meeting, he should like to ask from whom that remarkable statement emanated. Of course, the daily paper reporter swallowed everything that was told him; but he (the speaker) went and looked at the place, and saw at a glance that there could not be half that space. He himself had had it measured that day, so as to be quite certain, and he should like to ask their attention to one or two little figures. On the plan which was to be published in the Journal [see illustration facing page 288] by the scale the length of the Gower Street front when completed was to be 213 feet. He had measured it carefully, and up to the centre from the corner to the central axis it was 237 feet; that left 24 feet on each side of the centre—that is to say, the magnificent opening in the view was 48 feet from one corner to the other. He thought they could not accept that view as exactly representing the facts, and he therefore wanted to know why the public were informed that there was going to be 100 feet opening. There was something else beyond that. The semicircular porches on the plan which was to be published in the Journal projected 21 feet beyond the main line of building. That together left just 6 feet between them. [The speaker here produced a block plan of his own, which he said showed exactly how it would work out.] He did not think there could be any view of the cupola like that shown in the drawing, which he thought was a delusive view, and he would like to know, unless it was proved to the contrary, whether the Council really meant to include that as an illustration in their Journal, because his opinion was that they would be misleading their readers if they did. At all events, he wished to put the general proposition that the building by Wilkins was a great possession, was a very valuable and remarkable building, and he thought it was being treated without sufficient regard to its original architectural design, and that the illustration referred to did not show correctly what was to be carried out.

Mr. R. ELSEY SMITH [*A.*] said that, as he was working in conjunction with his father in the matter, and had had to do with the measurements of the building, he would like to answer Mr. Statham's statement on that fact. He thought that he knew how Mr. Statham had been led into the error, because he had assumed, what he (the speaker) had always assumed, that the centre of the two porches which formed the entrance to the College was in the same centre line as the centre line of the portico. That was not the case; there was a difference of 10 feet [see the speaker's note at end of Discussion] between the axis line of the portico and the axis line of the present gateway of the College; and 10 feet on either side of the centre line threw an extra 20 feet into the space that Mr. Statham had described as so narrow. There was not, of course, 100 feet between the two, and it was never intended that there should be; and how anyone came to make that statement he could not answer. But, as a matter of fact, the drawing referred to had been set up by Mr. Brewer from actual measurements as the whole dimensions of the front had been set out, and Mr. Brewer had sufficient reputation, he thought, for them to consider his drawing as accurate. He thought he could explain how easy it was to make such an error in the measurement of the front. No one from looking at it in the street would detect that the axis of the present gateway was not on the axis of the great centre portico; it was natural to assume that it was; but, as a matter of fact, from careful measurement of the whole of the central area, he might state that it was not the case.

Mr. STATHAM [*F.*] said that the gate was shown central with the axis on the large scale ordnance map, which he compared with the building, and it was easy to see when one was on the axis by standing opposite, on the other side of Gower Street, and getting the position in which the cupola stood symmetrically over the columns —which he did—and he was quite certain that the gate was not 10 feet away from the axis, nor anything like it.

Mr. WILLIAM WOODWARD [*A.*] said that such questions of measurement were, of course, questions of fact, and it seemed very extraordinary that Mr. Statham should go to the building and make the error which, according to Mr. Elsey Smith, he must have made to account for the difference of 10 feet. But, apart from that, Mr. Statham's criticism appeared to be based upon the fact that Professor Roger Smith had not done what Wilkins intended should be done with his building. He (the speaker) had not the slightest doubt that, had Wilkins been commissioned to erect laboratories in the latter part of the nineteenth century, with the contracted site that he had to deal with, he would have had to place those laboratories somewhere; and if Mr. Statham would for a moment direct his thoughts to Oxford, he would find that, however beautiful the dome and portico of University College were, they would not be hidden from view even by the contracted dimensions in front that he referred to. According to the block plan, they had only to enter into the quadrangle and admire to their hearts' content Wilkins's beautiful work. Therefore he could not see that the slightest blame attached to Professor Roger Smith for having dealt with the exigencies which the latter part of the nineteenth century demanded, and which Wilkins had nothing whatever to do with when he designed University College. Mr. Statham had not criticised the architecture of the new building at all; he had not ventured to criticise Professor Roger Smith's addition to University College. The front to Gower Street, if he might be permitted to say so, was a plain, straightforward classic front, showing due regard, even in its smallest detail, to the original design of Wilkins. Therefore Professor Roger Smith, having been commissioned to erect the buildings, and having a site which he could not enlarge, had satisfactorily got over the difficulty, and they would have in Gower Street what they had in Oxford—a proper collegiate quadrangle.

Professor CAPPER said that in taking part in the discussion he must apologise for doing so, not as an architect, but as an engineer. He had had the privilege of being a student at University College under Professor Kennedy, when he was professor there, and he took great pleasure in putting upon record the immense amount that he owed to the study which he carried on there under the Professor's system of laboratory teaching. All who were teaching engineering looked up to University College, and to Professor Kennedy, as being the pioneer in the present system of laboratory instruction for engineering students. He (the speaker) was at present connected with what used to be considered as a rival institution, but which was really a friendly co-operative institution—King's College. The arrangement there was somewhat intermediate between the state that Professor Unwin suggested and the one which Professor Beare had upheld in his arrangement of the laboratory. He thought he was right in stating that King's College was the first to systematically organise the workshop training for engineering students which Professor Unwin had adopted, and with his views he entirely agreed. It had been his (the speaker's) endeavour to so modify the teaching there as to make the workshops preparatory and complementary to a laboratory such as that described. He had at present a very well-equipped laboratory, which had about 2,500 feet of superficial area, in addition to carpenters' shops and workshops which took up over 3,000 feet more. Unfortunately the buildings that he was using at present were not specially adapted for the purpose in hand; they were more or less in the same

state as regards accommodation that the laboratory at University College was in before the change was made. Schemes were on foot to bring about what he hoped would be a counterpart to the laboratory described, and that, he thought, together with University College, would stimulate in London—as Professor Unwin's teaching at the Central Institution had stimulated—high scientific instruction for engineers. As to workshops, he entirely endorsed what Professor Unwin had said. If they did not get a student who had been in the workshop through actual factory training, it was almost essential that something should be done to give him facility in the use of his fingers before he could profit by experimental training, and, secondly, to give him some acquaintance with the practical working of the tools, machines, &c., which one had to refer to in one's lectures. He had had a number of students who had previously been through the factory, and here and there he found one who had kept up his habits of study, and consequently could be taught in a very efficient manner. But these were exceptional cases. It was practically very difficult to do so. And therefore, as it was impossible to sandwich factory and college, at any rate in London, the greater number of students wisely came straight from school to college. For such it was essential to provide systematic practical instruction of a limited kind, not in any sense to replace factory training, but to enable them to comprehend what one was lecturing about; and it was this principle that he had followed.

Mr. C. FORSTER HAYWARD, F.S.A. [*F.*], referred to the way in which Professor Roger Smith had constructed his laboratory and some of the details connected with it, and said that he had himself had some experience in such matters, and he knew the difficulties of working the details in an architectural building. As an old schoolboy of University College, he was thoroughly acquainted with the building before any wings were added, and he must be allowed to condole with his friend Professor Roger Smith in having had put upon him the necessity of blocking out the delightful view of the dome and the building of University College. He must feel, as all of them felt, that, whatever the exigencies of the case, it was a misfortune to lose the view of such a delightful object of architecture, which was evidently designed by Wilkins to be seen from Gower Street. Even the Professors of University College ought to have thought very seriously over the matter before they took that space of ground. Would it not have been possible to pull down one or two houses at the back, where the laboratories were, and to have added a series of laboratories all connected together, all connected with the theatres, all connected in one way in the most central position? This, he thought, would have been much better for the purpose than bringing the laboratory to the front of Gower Street, where there was considerable traffic. For his part, he should ever regret—as all those who as schoolboys had grown up to love the buildings of University College would regret—not only as an architect but in every other sense of the word, that they should appear to be doomed to lose the delightful view of the quadrangle. A quadrangle to be worth anything must be very much deeper than the new buildings allowed, and it should have a very much wider opening than anything there provided. No doubt the exigencies of the case, as Mr. Woodward had said, would have compelled Wilkins to have done something; but he thought he would have hesitated before he built out quite so much as appeared to be intended to be built out. Was it not quite possible to save a considerable piece by finishing the building in a different way from that designed—finishing it as it now was, and not putting another storey on the Physical Laboratory? It was quite possible, he submitted, to design it in such a way that the dome itself, from a distance at any rate, would not be hidden out; and there was no reason, so far as he could see, why it should not be finished with the walls as they now were. Professor Roger Smith, he was sure, could do it much more effectually architecturally than the way in which it appeared likely to be carried out if he had the backing up of the Council of University College. He hoped that they would reconsider the matter, and remember that they were the custodians of a very fine and handsome building, which was never intended to be so built out, and that they would actually be destroying a very important part of the architecture of London if they carried out the plan proposed. It would be quite possible, he was sure, to purchase some of the houses at the back of the College and to add more there if necessary. Why not, at any rate, purchase those three or four houses in Gower Street on the right-hand side, and open out the school playground a little more? He knew it was quite on the cards that the school itself might be removed elsewhere, and so more room would be gained to build on that site than appeared on the plan.

Professor CAREY FOSTER said that he personally was under a great debt of gratitude to Professor Roger Smith and to Mr. Elsey Smith for the extremely great trouble they had taken in their efforts to meet his views in the planning of the Physical Department of the College in every detail that presented itself. The matter was not altogether a straightforward one, from the peculiarities of the buildings they had to deal with—he meant the adaptation of the pre-existing buildings. The new part was straightforward enough; it was a fresh start, and they could do what they liked, so far as the site went; but on one side they were dealing with an existing building which was divided into definite units of length.

Windows, as shown there, appeared at rather close intervals, and the piers between them could not be interfered with in any way, as they carried the whole weight of the superincumbent block. And not only was there that limited possibility of dealing with the space, but there were also iron columns supporting the floor above, which also to a considerable extent limited the possibility of dealing at will with the space. They had to divide the floor in consideration of those fixed points. But he thought the result had been that University College now possessed as good a physical laboratory, taking it on the whole, as any similar institution in the country, and was well adapted for the purpose. Complicated arrangements were avoided as far as possible, so that the plan might be left elastic, and any new requirements might be met as they grew up from time to time.

Professor HUDSON BEARE wished to add his testimony to that of Professor Carey Foster as to the very great debt of gratitude they owed to Professor Roger Smith and Mr. Elsey Smith for the way in which they had carried out their views and desires in the new buildings. On the limited ground to which they were tied down, it was no easy matter to scheme provision for all their requirements, and it was entirely owing to the extreme care taken by Professor Roger Smith that the result had been so satisfactory. He had been in occupation of his floor since last October, and he had found it meet his requirements in every point; and if Professor Fleming had been able to be present he would have said the same thing. They were delighted with the whole place; it was convenient for work, well lighted, well heated, and remarkably free from noise, considering that it stood on a street open to a large amount of traffic. Owing to the double windows and the substantial nature of the whole structure, they were not incommoded in the least by the noise of the traffic. In his own laboratory on the ground floor he could not hear the street noises in the day at all. In the first-floor lecture-theatre the noise of the traffic was heard, but not sufficiently to impede lecturer or students attending. A question was asked as to the floor of the theatre on the first floor being a flat floor and not raised. It was done at his own desire and that of Professor Pearson, who lectured there. Nothing was shown practically in the way of experiments; it was very largely models and blackboard work, and for that purpose it was not so essential that the pupils should be on raised benches. The lecturer's platform being raised considerably above the floor level, the blackboard was in full view of the students, and there was no difficulty even in the back benches in seeing everything that was going on. It was done partly to gain more accommodation, and partly that they might get about among the students during demonstrations and exercise class-work, and it was found very satisfactory. There was one point of very considerable importance, not merely to engineering laboratories, but to all buildings at the present day where machinery and plant which are likely to cause vibration are to be placed in buildings used by other people, and that was the method adopted of cutting off the vibrations from the walls. It was the method adopted in the dynamo-room and also in his own engine-room. The whole of the concrete of the floor was separated from the main walls, the space being filled in. He had to lecture on the floor above, and, though the 90 horse-power gas-engine in Professor Fleming's dynamo was running constantly all day, there was not the slightest vibration, although the shafting was attached to the wall, which just joined the wall of the main building. He himself could not tell whether the machine was running or not; the silencing chamber was most effectual in deadening the noise. With reference to the teaching of students in laboratories and workshops, he knew that Professor Unwin had had a wide and varied experience in teaching engineering; he deservedly held probably the premier rank in teaching engineering; and therefore his opinion was one worthy of attention by everybody. To a certain extent, he (the speaker) agreed with what had been stated. He did not mean by the paragraph on page 291 that they did not attempt to teach handicraft. They did do that, but only to a limited extent, because all their students invariably passed from them into the workshop afterwards, and served an apprenticeship, or had come from the workshop, and their time was so taken up with lectures and laboratory work and drawing work that it was difficult to find spare time. What little time they had he had taken up for that very purpose of handicraft work—not in his old laboratory, but in the new laboratories he had made that new departure, and as time went on he hoped to increase it. He had not found, however, that students who came from workshops were so unsatisfactory as Professor Unwin said they were. One or two of the best students who had left University College had been students who had already served an apprenticeship in factories and workshops; and they were the most satisfactory students, because in the factory and workshop they had learnt the value of time, and the necessity of taking advantage of every opportunity put before them. Young lads who came straight from the restraints and discipline of school into the freedom of a college such as University College very often failed to do so, and their college course was not as satisfactory and useful to them as it might have been if they had learnt by previous experience, in the practical work of life, the value of taking advantage of all their opportunities.

The PRESIDENT said it was extremely satisfactory to hear, upon the authority of the learned

professors who had made use of the buildings since their erection, that they answered admirably the purposes for which they were designed. The architectural question was, of course, one which must interest architects, and could not fail to do so. The facts brought forward by Mr. Statham certainly appeared to be very circumstantial. He was not a man, he thought, who was likely to make statements of the kind without having carefully satisfied himself as to their accuracy; at the same time he could scarcely think it credible that any architect of experience or repute would so set out additions to a very important public building as to produce the result that the buildings on either side of what was intended to be a wide central opening should be within six feet of touching each other. He could scarcely believe that credible, and no doubt the result would prove that some error had crept in to account for it. With regard to the façade itself, if it had been possible he confessed he should have liked it had the opening in question been more of the proportions indicated, he supposed in error, by Mr. Statham's informant. If it had been 100 feet instead of 50 feet wide they would all, no doubt, have been pleased. At the same time, it was fair to remember that the circumstances in the days of Wilkins, when the building was designed, were very different indeed from the circumstances of the last stage of the nineteenth century; and had Wilkins for one moment conceived what the century would have produced, possibly he might have indicated a very different completion to his building from that which he thought of. In any case, the pressure put upon Professor Roger Smith to obtain the accommodation was, no doubt, very severe, and he hoped he would receive in good part the slight criticism he (the President) had ventured to make; indeed, he had little doubt but that it received his full architectural sympathy.

Professor T. ROGER SMITH [*F.*] acknowledged the vote, and wished very cordially to thank his colleagues who were using the new buildings for the kind way in which they had testified to the fact that they found themselves comfortable. He thought that was very much due to the fact that they knew what they wanted, and were able to give the necessary advice and the necessary instruction, and were willing to take any amount of trouble until the thing was got as right as it could be got. One point upon which he was rather strong was on the question of the sloping floor; and he had an experimental proof, because the class-room in which he had lectured himself for years used to have a raised floor, and within the last few months the College had judged it expedient to flatten his floor, to suit the views of the gentlemen who taught geometrical drawing on a flat floor, and he found the room far less comfortable to speak in on two grounds—first, he could not command the students so thoroughly as he could when those in the rear were rising a little above the heads of those in front; and, secondly, it was a far less pleasant room to speak in. On both grounds—because the lecturer could see his audience, and because the wall opposite to him was screened by the audience and the echo was lost, which even in a small room was often occasioned by a wall directly facing him—the sloping arrangement of seats was, in his opinion, desirable in any lecture-room and any class-room. As to the architectural question, when he (the speaker) rather designedly made the subject a technical paper only—it was arranged with the Science Standing Committee—it appeared to him that if the work he had to do had any claim to be considered, it was because science pursuits were assuming great proportions, and he might be able to furnish a certain amount of information which might be useful to his colleagues as to what was necessary in any well-equipped scientific laboratory, and he kept to that text. He felt that the responsibility of dealing with a building with the architectural claims that University College had was very great; but, when the undertaking was started, several gentlemen, members of the Building Committee, were Oxford and Cambridge men, and their wish was to enclose the quadrangle entirely, and they quoted the case of several colleges in each of those Universities which were magnificent buildings, and the beauty of which was not seen until the quadrangle was entered. He thought that a building which was entirely a quadrangle had a dignity and nobility which a three-sided building open to the street had not; and he was not at all sure that University College would not have gained rather than lost if, supposing the building to be carried out entirely, it had been enclosed. At the same time, he had fought rather hard for the retention of the centre opening, and what had been arranged was the result of a compromise. He should not have the smallest objection, if he ever had the honour of completing the building, but should be only too glad that the gap should be wider than was shown upon the plan; and, as Mr. Hayward had pointed out, there was no difficulty in the building being finished at the point where it now ended. But he entirely disclaimed the imputation that they had spoiled the building by shutting it in. A quadrangle was a very natural feature of a building—of a collegiate building especially—and a three-sided building did not, strictly speaking, possess a quadrangle; and in many points of view the quadrangle, as it was at present, had a comparatively incomplete look. He quite admitted that from Gower Street the splendid portico and steps were now better seen than they would be when the building was completed like the design on the walls; but the demands for accommodation had been imperious and were imperious; and he believed that at no very distant time it would be necessary to

carry out practically the design illustrated in the drawings. If Mr. Statham would stand between the two porches and look at the Hospital, he would find that the centre of the Hospital was not then opposite to him. [Mr. Statham was understood to say that he had noticed it.] The Hospital was, no doubt, set out exactly opposite to University College, and it was a striking thing, when attention had once been drawn to it, that the centre doorway of the Hospital did not face one when one stood between the two porches, which was a rough way of recognising that what Mr. Elsey Smith had said was correct. In conclusion, he would say that he admired Mr. Statham for the interest the latter took in what was one of the architectural beauties of London; and if Mr. Statham had been led to push his view rather harder than he should have wished him to push it, at the same time he quite recognised that there were but few men who had any zeal for architecture, and still fewer who were in the position which Mr. Statham enjoyed of being able to say a word in season which would be heard by the whole of the public with regard to architectural buildings. He therefore acknowledged that the duty fell upon Mr. Statham, more perhaps than it did upon most people, to be a jealous guardian of their architecture at large, and he recognised that *The Builder* had, in countless instances, done good service in that respect.

Mr. R. ELSEY SMITH [*A.*], referring to the figures given in his remarks [p. 304], has forwarded a correction as follows:—

I have since referred to the drawing from recollection of which I spoke, and find that the distance there shown between the axial line of the centre of the pediment is five feet, not ten, as I stated from memory.

Mr. H. H. STATHAM [*F.*] has forwarded a note as an addendum to his remarks [p. 303] as follows:—

With reference to Professor Roger Smith's remark about the doorway of University Hospital in his reply, allow me to say that he is mistaken if he supposes that the door of the Hospital is central with the College buildings. A glance at the Ordnance map might have shown him the contrary; and if he stands on the middle of the step of the Hospital doorway, and looks at the College, he will see the apex of the cupola perceptibly to the left of the apex of the pediment, showing that he is on the left of the axial line.

CHRONICLE.

THE INTERMEDIATE EXAMINATION.

At the General Meeting of the 26th ult. the President announced that an Intermediate Examination to qualify for registration as Student had been held at the Institute on the 20th, 21st, and 22nd ult.; and that of the 38 Probationers who applied, there had been admitted 36, of whom 35 presented themselves and were examined. Twenty-one had passed, twelve had been relegated in three, four, or five separate subjects, and two in all subjects. The President further stated that the majority of those relegated had failed on subjects II. and IV.: namely, "The Several "Varieties of Classic Ornament," and "The "characteristic Mouldings and Ornament of each "Period," in which accuracy of delineation is indispensable. He was of opinion, from information he had received from the Board of Examiners, that no one need feel disappointed by being relegated; on the contrary, experience showed that it was of the greatest possible advantage to students that they should be relegated, because they thereby had an opportunity of making themselves much more familiar with the subjects in which they had failed than they were before. The twenty-one, placed by the Board of Examiners in order of merit, are:—

INNOCENT: Charles Frederick; 18, Wellesley Road, Sheffield [*Master*: Mr. C. J. Innocent*].

THOMSON: George; 20, Lyddon Terrace, Leeds [*Masters*: Messrs. Perkin* & Bulmer*].

HUNT: John; 18, Dorset Square, N.W. [*Master*: Mr. F. W. Hunt*].

CHAPMAN: Henry Ascough; 52, Newborough, Scarborough [*Master*: Mr. J. C. Petch].

{ BLOW: Percival Cherry; St. Peter's Street, St. Albans, Herts [*Master*: Mr. A. H. Tiltman*].
{ OWEN: Richard Herbert; 293, Clapham Road, S.W. [*Masters*: Messrs. Jennings* & Bucknall].

NELSON: Clement Osmund; 16, Scarsdale Terrace, Kensington, W. [*Master*: Mr. J. Butler].

PRICE: Llewelyn Bankes, B.A. Oxon.; 64, Cannon Street, E.C. [*Master*: Mr. Charles Henman*].

OWEN: Segar; Newholme, Grappenhall, nr. Warrington [*Master*: Mr. W. Owen*].

DEVALL: George Harry; St. Elmo, City Road, Birmingham [*Master*: Mr. Alfred Long].

SHEPHERD: Herbert; 37, Larkfield, Richmond, Surrey [*Master*: Mr. John Scott].

HILL: Richard Henry Ernest; 3, Lombard Court, Lombard Street, E.C. [*Master*: Mr. R. H. Hill*].
HARRIS: Charles William; 96, Durning Road, Edge Lane, Liverpool [*Master*: Mr. H. Hartley*].
POTTS: Henry Miller; 13, Windsor Terrace, Newcastle-on-Tyne [*Master*: Mr. Joseph Potts].
GRAYSON: George Hastwell, B.A. Cantab.; c/o Messrs. Willink & Thicknesse, 14, Castle Street, Liverpool [*Masters*: Messrs. Willink* & Thicknesse].
HARRISON: Arthur; 99, High Street, Stockton-on-Tees [*Masters*: Messrs. Wetherill & Whipham].
NEWMAN: Percival Corney; 33, Cologne Road, New Wandsworth, S.W. [*Master*: Mr. G. Hamilton Gordon*].
MOSLEY: Wilfrid Rowland; 4, Clarendon Place, Leeds [*Masters*: Messrs. Chorley* & Connon*].
ALDRIDGE: Ernest Charles; Central Buildings, North John Street, Liverpool [*Master*: Mr. C. Aldridge*].
RICH: Roland; 6, Jesmond Gardens, Newcastle-on-Tyne [*Master*: Mr. F. W. Rich].
BORISSOW: Ernest; Vicarsbrook, Chaucer Road, Cambridge [*Master*: Mr. W. M. Fawcett,* M.A. Cantab.].

The asterisk (*) denotes Members of the Institute.

The twenty-one Probationers just passed, added to the fifteen who passed in November, increase the number of Students on the Register to 109.

Election of an Auditor, 1893–94.

At last Monday's General Meeting, in pursuance of notice given on the 15th ult., Mr. F. W. Marks [*A.*] was elected an Auditor by Resolution of the Institute. This was necessitated by the fact that Mr. G. A. T. Middleton [*A.*], who had been elected the Associate-Auditor by the Annual General Meeting of last May, is compelled by absence abroad to relinquish the duties of the office.

Visit to the Works of Decoration at St. Paul's.

The opportunity afforded members last Saturday, through the kind offices of Messrs. James Powell & Sons and the courtesy of the Dean and Chapter, of visiting St. Paul's for the purpose of inspecting the new Mosaics was taken advantage of by some sixty members, the President, Hon. Secretary, and several members of the Council being among the number. Mr. James C. Powell acted as cicerone, and the keenest interest was evinced by all present in the very beautiful work his firm are executing from the designs and under the direction of Mr. W. B. Richmond, A.R.A. One would like to have seen a practical illustration of the methods of working treated of by Mr. Powell in his Paper, and the actual manipulation of materials by the workmen, but it was a half-holiday, and the wish could not be gratified.

Architects' Benevolent Society.

The Annual General Meeting of the Architects' Benevolent Society will be held at 5 p.m. on Wednesday, the 14th inst., in the rooms of the Institute. Mr. J. Macvicar Anderson, the President of the Society, will take the Chair. Members of the Institute are invited to attend the Meeting, at which the annual report and balance-sheet of the year 1893 will be submitted.

Hygiene and Demography.

The eighth International Congress of Hygiene and Demography will be held at Budapest from the 1st to the 9th September next, under the patronage of the Emperor of Austria, and the presidency of Count Karolyi. It will be remembered that the last Congress was held in London in August 1891, under the presidency of the Prince of Wales. In forwarding the Provisional Programme, the executive committee invite the co-operation of all public bodies concerned in works relating to public health and hygiene, and urge upon the Institute the advisability of nominating delegates to represent the corporate body at the Congress. The subjects for discussion are to cover a much wider field than those treated at the London Congress, the divisions under the head of Hygiene alone numbering no fewer than nineteen. Sections 1 and 2 deal with the Ætiology of Infectious Diseases and the Prophylaxis of Epidemics; sections 3 to 6 with the Hygiene of the Tropics, of Trades and Agriculture, of Children, of Schools; section 7, Articles of Food; sections 8 to 11, Hygiene of Towns, Public Buildings, Dwellings, Communication (Railroads and Navigation); 12, Military Hygiene; 13, Red-Cross Societies; 14, Saving of Life; 15, State-Hygiene; 16, Hygiene of Sport; 17, Baths; 18, Veterinary; 19, Pharmacology. The office of the Secretary-General, Professor Dr. C. Müller, will be at the Rochus-Hospital, Budapest, until the 20th August 1894, and after that date at the Royal Joseph's Polytechnicum of that city.

Additions to the Library.

The Library has acquired a folio on a subject on which there are curiously few authorities. *Die Holzbaukunst Norwegens* is a German translation of a Norwegian work of Professor L. Dietrichson (of the Christiania University) and Herr H. Munthe, and deals with the wooden architecture of Norway, mediæval and modern. The work is divided into three parts: (1) wooden churches, (2) secular architecture of mediæval times, (3) contemporary wooden architecture; and contains, besides thirty-one plates, over two hundred illustrations in the text. Other recent acquisitions are a couple of copies of the second edition of Fergusson's *Handbook of Architecture* (London, 1852), for the Loan Collection; and *Excursions in the County of Kent*, by T. K. Cromwell (London, 1822). The last volume comprises brief historical and topographical delineations, accompanied by some fifty delicately executed engravings. The publishers, Messrs. E. & F. Spon, have kindly presented their *Builders' Price Book* for 1894, by Mr. W. Young [*F.*].

Additional information has been added to this latest edition of a useful book, including a chapter on electricity, with complete specifications and estimate of electric-lighting installations.

Professor L. Cloquet, of the University of Ghent, architect, has forwarded his *Essai sur les principes du Beau en Architecture* [Société de Saint-Augustin, Desclée, De Brouwer et Cie., Place du Lion d'Or, 8, Gand, 1894], composed with great care, and eminently practical in its argument and deductions. The Essay is divided into nine chapters, the most interesting being (V.) Decoration, (VII.) Harmony of Proportions, and (VIII.) Symmetry. Monsieur A. Barthélemy has presented his Report to the Director of the Beaux-Arts in France upon *L'Organisation des Arts aux Etats-Unis*, which was originally published in the *Bulletin des Musées* of March–May, 1893 [Imprimerie Garnier, 15, Rue du Grand-Cerf, Chartres; 1893]. In America, he says, the future belongs to the Western States; and he lays stress upon the influence which the Chicago Exhibition will have upon the artistic movement in the United States.

The Superintendent of the Department of Revenue and Agriculture, Calcutta, has forwarded a pamphlet on the Kalyani Inscriptions of Dhammacheti, by the eminent authority Mr. Taw Sein Ko, who has been entrusted by the Government with their restoration. A well-known pamphlet has been received from the author, Mr. William Simpson [*H.A.*], entitled *The Tower of Babel, and the Birs Nimroud*, originally published in the *Transactions* of the Society of Biblical Archæology, vol. ix. pt. 2, 1888; and a reprint of the Paper read before that Society.

The Society of Architects of Russia has forwarded from St. Petersburg the various parts which constitute the volume of the Russian *Architect* for 1893. These contain sixty plates of recent Russian architecture; and, so far as one may judge from the names attached to the plates, the works have been mostly designed by architects of French, German, and Scandinavian nationality.

THE TRANSACTIONS, N.S. 1885–1892.

As there apparently exists in the minds of members of the Institute some misapprehension respecting the change which took place, last November, in the issue of the first number of a "Third "Series" of the JOURNAL, it may be useful to state definitely that the "New Series" of the TRANSACTIONS was concluded at the end of 1892, and that there is no intention of continuing them in the old form. The principal Papers read at the Sessional Meetings of 1892–93 appeared in full in the ninth and concluding volume of *The R.I.B.A. Journal*; and those few that were not published in full and illustrated appeared in that same volume in abstract. For some years prior to 1893 it was usual to publish a fortnightly periodical during the Session, and at its close an annual volume. These two publications are now merged into one, the present JOURNAL, which this Session bids fair to make a volume of some 700 pages, exclusive of plates, lithographic illustrations, index, &c.

Under the old system, it was usual to publish on the subsequent Thursday an abstract of the Paper read at a Monday's General Meeting, with a full report in the first person of the discussion which followed the reading of the Paper, and to publish the complete Paper with a number of illustrations in a separate volume, which appeared at the close of the year. The result in many instances was that the fortnightly journal was regarded as a circular ultimately intended for the waste-paper basket, and the annual volume treated as a kind of keepsake, which was generally looked at but rarely read. Under the new system, the full Paper, with all its illustrations and the discussion upon it, appears in the JOURNAL—the only publication of the Institute, except, of course, the *Kalendar* and sundry Papers – three days after delivery at a General Meeting, and in a form that admits of conversion, at the end of a Session, into a bound annual volume, the cost of which in its complete state will be similar to that of a volume of the old TRANSACTIONS, though it will contain at least 250 pages extra of text, namely, twenty-four shillings in stiff paper covers, with the corporate seal in brown on the face, or twenty-six shillings bound in cloth with leather back, and the corporate seal in gold on the face.

Recent inquiry into the stock of volumes and parts of TRANSACTIONS now held by the Institute has shown that, though several copies of volumes published in certain years remain, no complete set of the Original Series can be made up. But, as regards the "New Series," several complete sets remain, available for purchase, at a cost of nine guineas the set of eight volumes, bound in thick paper covers, or ten guineas bound in cloth with leather back, as before described.

The so-called New Series of TRANSACTIONS, 1885–1892, eight volumes in all, must always possess exceptional value from the fact that comparatively few copies were published, that many of the authors of the Papers therein are distinguished in their line, and that most of the illustrations with which the volumes are embellished are extraordinarily good. The first and second contain, with 20 other heads of subjects, Mr. Alex. Graham's remarkable Papers on the Roman Occupation in North Africa, mainly illustrated from sketches and measured drawings made by himself, and from a few photographs. The third volume is especially valuable on account of Mr. T. G. Jackson's Paper on the Architecture of Dalmatia; the revised Notes, by Mr. Wyatt Papworth, on the Superintendents of English Build-

ings in the Middle Ages; and the late William Burges's famous Paper (reprinted) on Architectural Drawing in the Middle Ages. It also has Mr. Brindley's "Marble: its Uses as suggested by the "Past," with a map of the principal quarries worked in the time of the Romans; and Mr. William Simpson's "Mud Architecture: Notes "made in Persia and other countries," which has helped further than any similar communication to an elucidation of the Oriental methods of dome and vault construction. This volume also contains a Paper in French by M. Paul Sédille [*Hon. Corr. M.*], with an English translation, entitled "An Essay on the Revival of Coloured "Architecture in France," and a Paper in English by the Cavaliere Giacomo Boni [*Hon. Corr. M.*] on the Ca' d'Oro and its Polychromatic Decorations. In the fourth volume is another most valuable Paper by Mr. Brindley on "The Ancient "Quarries of Egypt," with an historical and topographical note by Mr. E. A. Floyer, and a geological map, &c., by Mr. W. Topley, F.R.S. The recent development of Vienna is also very ably treated therein by Mr. Farrow. In the fifth volume are, notably, Sir Richard Temple's "Picturesqueness in reference to Architecture," and Professor Baldwin Brown's "Origin of Roman "Imperial Architecture"; and, among several other subjects, the late George Edmund Street's contributions to the Institute TRANSACTIONS, in the way of Sessional Papers, are therein collected together, re-edited, and carefully revised, with all or most of the original illustrations, some being reproductions of Street's own drawings. Volume VI. contains twelve heads of subjects, amongst which are Mr. Gotch's "Renaissance in Northamptonshire," Count R. d'Hulst's "Arab House of Egypt," and Mr. Penrose's "St. Stephen's, Walbrook." Volume VII. has the "School of Bramante," by Baron H. von Geymüller [*Hon. Corr. M.*]; Mr. Starkie Gardner's "Wrought Ironwork: Mediæval "Period;" and Mr. H. W. Brewer's "Churches "in the neighbourhood of Cleves;" with nine other heads of subjects, some of which embrace several Papers by different authors. In Volume VIII. Mr. Starkie Gardiner continues the subject of Wrought Ironwork, taking up the period of the Renaissance; and the same volume contains Mr. Edwin T. Hall's Paper on London Building Legislation, with a Draft Bill, prepared by the Practice Standing Committee, for the codification and amendment of the Metropolitan Building Acts (first portion to end of Sections describing construction). Papers on stained glass, with numerous illustrations, are also to be found therein.

The eight volumes comprise 101 heads of subjects or combined contributions, with more than 900 plates and lithographs (some of double page), process blocks and zinco diagrams; and inclusive of portraits of Cockerell, Donaldson, Street, Viollet-Le-Duc, and Mr. Alfred Waterhouse, R.A. A facsimile in Volume VI. of a pencil sketch, by Ingres, of the late Professor Cockerell when a young man, and another in Volume VII. of a pencil drawing by Mr. H. W. Brewer, are of their kind two of the finest specimens of wood engraving.

NOTES, QUERIES, AND REPLIES.

Fresco and other Decoration fifty years ago.

In connection with the subjects which engrossed the attention of the General Meeting of the Institute on the 12th ult., it will be found interesting, and not perhaps unprofitable, to hark back fifty years, and see what was thought and written on Fresco-painting by experts of that day. Prominent among these was the late Mr. E. T. Parris, who dealt with the matter in a Paper on "The Application "of the Higher Branches of Painting, especially "in Fresco, to Architecture," read before the Institute on the 14th of February 1842. The MS. is in the Library, and the passages here quoted from it are fairly representative of the author's views:—

As a decoration it surpasses every other mode of painting; its grand and impressive tone of colour, with a boldness and decision of outline rejecting all meretricious ornament, and its combining with large masses of architecture, give a dignity and majesty commanding silence and admiration. . . . I must observe that much of the richness and brilliancy of Fresco depends on the stucco ground reflecting light through the colours applied. . . . The artist, however, will be greatly disappointed who imagines the same effects will be produced as in oil, or that he can trifle with Fresco by improving his first sketch or idea. There can be no toning down, no glazing with maguelps or mediums, no magic touches, no fortunate accidental effects – in fact, there is no retouching in Fresco. Each part must be matured on the cartoon from which the picture is to be painted – all is sober, steady, hard work on a damp wall, perhaps with the inconvenience of a new building, away from home and a warm studio; all trifling details so fascinating in themselves must be avoided, everything must be generalised. Grand, powerful, and severe, the artist must live, as it were, in a bygone age, with statues, heroes, temples, and monuments ever in his thoughts, and forget the temptations of annual exhibitions. He must be assisted, not by workmen, but by pupils who are likely to rival if not surpass him; he requires space at home to prepare his cartoons, he must lay his own grounds, or see it done himself; his physical strength must equal his enthusiasm, no fear of danger when on elevated scaffolds; nor will his work either progress or have the desired breadth of effect unless he works long days without intermission, for when the plaster is once set he can do no good except by ripping it off with the trowel, if he wishes to make an alteration.

A further quotation from the same Paper may be permitted, as possessing some local interest at the present moment:—

It will be remembered that in 1821 a new ball and cross were placed on the summit of St. Paul's Cathedral, and as the interior was intended to be cleaned, the question was much agitated respecting the paintings in the dome by Sir James Thornhill. It was stated publicly that the expense of raising a scaffolding would be so great that but faint hopes were entertained of its being effected. I immediately turned my attention to the subject, and con-

trived an apparatus for the purpose of getting at the paintings. The model remained by me until 1829, when Mr. C. R. Cockerell, desirous of seeing the paintings cleaned and restored, submitted the model in the most liberal manner to the Dean and Chapter, introducing me at the same time as the inventor. The apparatus was considered adequate to the purpose, and my estimate for restoring the whole of the painting, gilding, &c., above the Whispering Gallery was £1,000, and no charge for scaffolding! But this sum was too large, and the plaster has been dropping from the wall ever since—it had then decayed above five feet all round the dome, and I am certain that in a few years the whole of the brickwork will be exposed. What would H.M. the King of Prussia think on entering our Metropolitan Cathedral! . . . The artists of this country are now expected to come forward and prove their abilities. How often they have done so, but how coldly they have been received! When Barry proposed to paint subjects on a large scale gratis for St. Paul's, with Reynolds, West, Dance, &c., the answer from Dr. Terrick, the then Dean of St. Paul's, was that "he was determined "never to give way to Popery by having paintings in "churches." Reynolds returned to his portraits to enrich his country in that way, and Barry to paint the great room at the Society of Arts in the Adelphi.

It is curious, wrote Mr. Parris, to note the scale of charges for architectural decoration in England during the last 200 years—that is, from the arrival of Rubens, in 1630, to 1730, when Thornhill was in his zenith, and from 1730 to its almost total extinction (*sic*) in 1842. According to him, the sums paid *per yard* were as follows:

		£	s.	
1630.	RUBENS for the Whitehall ceiling .	7	10	per yard.
1670.	DELAFOSSE for the British Museum	7	0	
1690.	VERRIO (exclusive of gilding) .	3	12	
1725.	THORNHILL for Greenwich . .	3	0	
1730.	THORNHILL (pilasters) . .	1	0	

Verrio, when he became blind, received a pension of £200 for life. In 1775 Cipriani received £2,000 for cleaning (*sic*) the Rubens ceiling; and in 1777 Barry received by the exhibition of his paintings at the house of the Society of Arts £503 2*s*., the colours having been supplied to him without charge. These statistics may or may not be correct, and Parris does not say whence he obtained them. But the undercurrent of indignation at the employment of foreign artists, which accompanies his flow of eloquence, is quite genuine. "In the present state of Art [in 1842] "in this country," he says, "the historical "painter does all with his own hands. If he has "a commission for a large work, his time is not "spent in making careful cartoons and studies [which would have been the case had he painted in fresco, and consequently had around him in his workshop pupils and assistants], but is "evaporated in refining on his performance, "which, if publicly exhibited, is altered to suit "other pictures of different styles that will never "again be near it when in its proper destination. "The time of the artist is his bread. Patrons are "expected to reduce their rents; and, with the "present public cry for political economy, how is "it likely that we can compete with other "countries in price? We are then told that we "can neither paint nor draw in fresco, the real "truth being that others cover more space at a "less cost. . . . I trust that we shall be able of "ourselves, not only to embellish the Houses of "Parliament, but all other public edifices without "foreign aid—alike in oil, encaustic, and fresco."

The late Mr. John G. Crace, in a letter addressed to the Hon. Secretary, Professor Donaldson, read in General Meeting on the 6th November 1843, gave an account of the frescoes which came under his notice during a tour in Germany and the north of Italy, which he had undertaken with a view to studying the processes employed in Fresco and Encaustic Painting, to form an opinion as to the effects produced, and to judge how far those effects would surpass painting in oil, in appearance and in durability. This letter is also preserved in the Library, and the following are a few extracts:—

The effects produced surpass paintings in oil in solidity and clearness, but owing to the limitation of colours employed, there always appeared to me a certain yellow-brown, dry effect, and a want of the richness of paintings in oil. In the grand fresco by Cornelius of the Last Judgment I think this must be felt by all, and in the beautiful subject by Veith at Frankfort this defect is still more apparent. . . .

As to the durability of fresco, in the older examples that I noticed in Italy, though the paintings had preserved to a considerable extent their original colouring, yet the effect was in almost all cases impaired by the decay of the plaster ground, the surface of which had crumbled through the action of the atmosphere. At Venice, where works on a grand scale have been executed in both fresco and oil, I was curious to compare the relative defects and advantages of each, and found that, though the paintings in oil of some masters had much darkened, yet with others, particularly Paul Veronese, the effects were still clear and fresh, and, upon the whole, being in better preservation, surpassed the actual appearance of most of the frescoes. In the grand works lately executed at Munich, they have been too recently done to allow of an opinion being formed; yet in the exterior specimens at the Post Office and the Hop Garden signs of decay are very evident.

Upon the whole, reflecting on all I saw, considering the difficulties of execution, the liability of decay in the ground, and the impossibility of reparation if injured, I could not perceive any great advantage over oil. In this country must further be added the additional likelihood of decay from our damp climate and discoloration through smoke and fog. On the one side, it has great advantage in being seen to perfection in all lights, and therefore particularly desirable for painting architectural effects in chiaro-oscuro, in the clearness and the soundness of its colours. On the other side are the disadvantages I have already enumerated.

With reference to the above, Mr. J. D. Crace [*H.A.*] states that, in 1843, his father went to Munich on purpose to ascertain what method of fresco was being used there, and how far it promised success. He was a good deal impressed by what he saw, which was, *at that time*, much in advance of other modern work. But in later years he was quite convinced that true fresco is, as a method, quite useless in England in large cities, where the acids from the coal-smoke attack and destroy the surface of the lime "intonaco," besides staining and saturating

the colours. It is often forgotten that the turpentine used in the so-called "spirit fresco" will become *quite as dark* as an oil medium with lapse of time.

The Decoration in Mosaic of St. Paul's Cathedral.

From R. PHENÉ SPIERS, F.S.A. [*F.*]—

The decorative works in mosaic now being carried out at St. Paul's are the outcome of an appeal to the public (made as long ago as 1858 by the late Dr. Milman, then Dean of St. Paul's) for subscriptions to a fund to complete the decoration of the cathedral in accordance with the intention of its architect, Sir Christopher Wren. The amount subscribed in 1871 had reached the sum of £40,000, when, on the occasion of the public thanksgiving held in St. Paul's for the recovery of the Prince of Wales, a special appeal was made, in consequence of which the subscriptions rose rapidly to £56,000. Through careful nursing, judicious investment, &c., this sum two or three years ago had grown to over £90,000.

In 1873 the late Mr. William Burges, who had made a special study of the iconography of the French cathedrals, was applied to for the production of designs, to be worked out in conjunction with Mr. Penrose, the architect of the cathedral. A model showing the same was exhibited in the Royal Academy in 1874, but it raised so great a storm of criticism from Churchmen of all degrees that nothing further was done for the moment. In June 1877 a sub-committee, appointed by the executive committee of St. Paul's to report on the best mode of proceeding in the execution of the decoration of the great dome in mosaic, recommended that the scheme proposed by the late Alfred Stevens (the sculptor of the Wellington Monument), on which he was working at the time of his death, should be accepted; that Sir Frederic Leighton, P.R.A., and Mr. Poynter, R.A., should be commissioned to prepare cartoons for the various panels, and Mr. Hugh Stannus (a pupil of Mr. Stevens) cartoons for the architectural framework of the design. This scheme also was set aside, but it will be remembered that in the Galleries of the Royal Academy in 1892, one of the circular panels, worked out subsequently by Sir Frederic Leighton, was exhibited, the subject being "The "sea giving up the dead."

It should be noted that for years work of some kind has been carried on in the great dome, the eight spandrils of which are filled with mosaics executed by the firm of Salviati of Venice from cartoons designed by Mr. G. F. Watts, R.A., by Mr. Townroe from Alfred Stevens's designs, and by Mr. Britten. Statues also are now being placed in the niches of the great drum.

The work now being carried out under Mr. Richmond, A.R.A., is confined to the choir; as regards its nature and methods, it was described by Mr. Jas. C. Powell at a meeting of the Institute held on the 12th ult., and reported in the last issue of the JOURNAL. The scheme of treatment, and the subjects with which it is proposed to decorate the choir generally, are, it is stated, to form the substance of a Report to be issued on the 5th inst. by the cathedral authorities.

A Primitive Mode of Construction still practised in the South of Italy.

From WILLIAM SIMPSON, R.I. [*H.A.*]—

It was as far back as 1869, on my first visit to Brindisi, that I noticed from the railway in passing Trani and Bari a peculiar kind of buildings in the vineyards and fields. These are very old towns, and are mentioned by Horace, who speaks of the fishy smells he encountered in them. The country is very rocky, with a slight covering of red soil, through which ledges of rock crop out, producing ridges; these, with the olive trees, of which there are large groves or forests, recalled to memory many places in Palestine. The cultivation of the olive is one of the chief employments of this part of Italy, and consequently there is a good amount of field-work required, and the peculiar buildings were evidently what we should call "outhouses" in connection with these operations. I still remember how I was attracted by these structures —watching them carefully as the train went along; and the conclusion grew upon me that, while the ordinary houses had changed as time advanced, somehow these field-buildings had been constructed from some primitive period without changing to any great extent the original type. It must be confessed that, from our knowledge of mutation which all building construction has undergone, this did not seem at all probable; but there were the buildings, and the puzzle was how to account for them by any other theory. I am now able, I think, to show that this first guess is in all probability the right explanation.

It was my fate to pass along the railway to Brindisi a number of times after the date mentioned, but it chanced to be always at night. In October 1878 I was on my way to India, and luckily on this occasion it was daylight when I reached Trani and Bari, and I was able from the train to make rough sketches. Sketches made under such circumstances can have no pretensions to perfect accuracy, and they ought to be accepted as only giving a general idea of the structures.

None were visible to the north about Foggia, but on reaching Barietta they began; at Trani and Bari they were numerous; a dozen, or even a score, of them might be all visible at one time. At Brindisi I could see none, neither from the train, nor in walks about the outskirts of the town. M. Perrot, to whom I shall have again to refer, says that "they still exist in the districts "of Bari, Lecce, Otranto, and Puglia." * Lecce

* *History of Art in Sardinia and Judæa*, vol. i. p. 47.

and Otranto are in the "heel of the boot"—the southernmost corner of Italy. Those I saw about Barietta were simple cone-shaped, small places, like figs. 1 and 2. These had generally a window, which in most cases was behind. As I came south some of them had the conical outline broken externally by one or two steps or terraces, as in figs. 3 and 4. Most of them are round in plan; but about Bari some were rectangular below, surmounted by a dome above [see fig. 5]; and one I saw of this kind had two domes to cover the roof [see fig. 6]. Some had narrow, rude stairs outside [see figs. 6 and 7]. One I saw had what seemed to be a kind of Persian water-wheel [fig. 7]. Very few were plastered, but I noticed one which was not only plastered, but was also decorated with large daubs of blue and red; this particular one may have been attached to a garden and used as a summer-house. MM. Perrot and Chipiez give an illustration of one of these places at Puglia, it is similar to fig. 4; and another in Otranto of the simple conical form, like figs. 1 and 2.*

The stones used in construction were small, and, so far as I could make out, no mortar was used. The enclosing walls of the fields were of the same kind of masonry—what a Scotch mason would call "dry dykes." In one or two instances there were lintels over the doors, but generally there were rude arches. I managed in one case to make a rough note of an arch [fig. 8], which is primitive enough in its form and construction. How the domes were constructed I had no chance of knowing, as I have not seen the inside of any of them; but from M. Perrot I learn that they are not on the arch principle. In a great many of them a stone, which had the appearance of a rude cross, projected as a terminal from the top of the dome.

The above are the principal data, according to my notes made at the time, but the circumstances under which they were made must not be overlooked when their accuracy is considered. Once, somewhere in the country, I met a botanist, with his vascullum slung on his back, riding. He asked me a question as to where he could find some particular *polypodium*, and I felt inclined to laugh at a botanist studying ferns on horseback; but it was reason of a high order in comparison with studying architectural details from a train running at full speed.

However slight my means of observing these peculiar buildings may have been, it turns out that my first impressions regarding them were fairly correct. On the occasion in 1878 when I made sketches from the train, an Italian gentleman in the carriage, seeing what I was doing, told me that they were ancient, and were for agricultural purposes, including animals—I assumed for housing them when necessary. He wrote the name they were known by, which is yet on one of my original sketches. It is "Capanna "o Pagliaia." This may be a local name, a kind of patois, and would mean something like cabin for straw or chaff. M. Perrot calls them "Truddhu," and connects them with the Núraghs of Sardinia, which was one of the ideas that occurred to me when I first saw them; and this led to my supposition that they were the continuation of a primitive form of building. At the same time I also thought of the so-called Treasury of Atreus, at Mycenæ, which is a tomb, and not a singular example of that form; if such a building had been constructed above ground, and not covered over with earth, it would have been only a variant of the same style of structure. The Brochs of the north, which have been likened to the Núraghs, are again another illustration of this primitive style. It will be noticed that fig. 6 differs but little from the houses in Jerusalem at the present day. From these examples, I come to the conclusion that the truddhus of Southern Italy are the descendants of a manner of building which was more or less common at some early period over a large portion of the Western world.

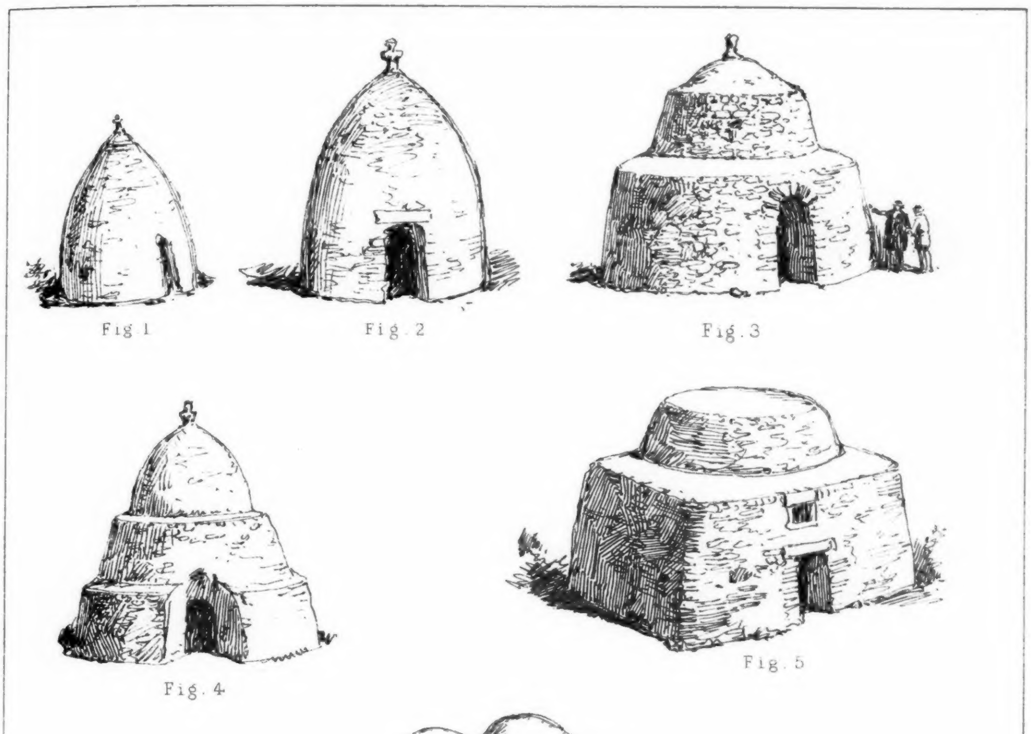
M. Perrot says that the name "truddhu" is from the original Latin, which was "trullum, "the *d* being equivalent to *l* in the local dialect."* He quotes Lenormant—and I copy the quotation, as it gives important details—who writes that the truddhu "is a massive conical tower, built almost "with uncut stones loosely put together, the "facing alone exhibiting more care in the fitting "and shape of the material, without aiming at "uniformity. The interior of the edifice is occu-"pied by a round vaulted chamber, shaped like a "'tholos'; this form being obtained by a series "of corbelled and superimposed courses. As a "rule, this is the only apartment on the ground-"floor, to which a low doorway, with a huge slab "forming the lintel, gives access. It sometimes "happens that the truddhu is of more than "ordinary size, when a second chamber is placed "on the second floor, which is reached by a narrow "winding staircase, always seen on the outside of "the building even when no second chamber "occurs; for it communicates with the paved "terrace on the top, investing the edifice with a "truncated, cone-like aspect. The terrace is "generally flat, but it assumes sometimes the form "of a circular, gently sloping roof, growing to a "point towards the extremity. When truddhi "are specially well constructed, the slope on the "sides, instead of being uniform, exhibits three suc-"cessive and slightly retreating gradations." † To this M. Perrot adds: "It will be seen that beyond "this relative size, the outward aspect, and posi-

* *History of Art in Sardinia and Judæa*, pp. 48, 49.

* *Ibid.* vol. i. p. 47.

† "Notes Archéologiques, sur la terre d'Otrante," *Gazette Archéologique*, 7^me^ année, pp. 32, 39, *specchie et truddhi.*

THE ROYAL INSTITUTE OF BRITISH ARCHITECTS
INCORPORATED SEVENTH OF WILLIAM IV. AND FIFTIETH OF VICTORIA.



Wm Simpson, R.I. del.

G. F. KELL, PHOTO-LITHO. 8 FURNIVAL ST. HOLBORN E.C.

A PRIMITIVE MODE OF CONSTRUCTION STILL PRACTISED
IN THE SOUTH OF ITALY.

" tion of the stairs, there is no difference between " núraghs and truddhi." * I must again quote from him: " Truddhi are used by the peasantry " as shelter and places to sleep in at sowing and " harvest time; their fields, being sometimes miles " away from their homes, induce absences of seve- " ral days, and even weeks, during which they can " hope for no better accommodation than what " they will find in their truddhi. Hence the " development of agglomerated núraghs is not to " be expected here, since they are but copies, on a " reduced scale, of an older and larger type exist- " ing in the same district, and called 'specchie,' " from the Latin 'specula,' watch-towers. Specchie " are in such a sad state of dilapidation that their " base lies buried under accumulated detritus, but " what remains shows that they were stone-built " structures, with truncated tops and outer facing " of more careful make than the interior, albeit irre- " gularly formed, similar in fact to modern truddhi, " save that their stones were on a much larger " pattern. Local opinion is divided as to the end " for which specchie were erected—whether as " monumental tombs, houses, strong signal towers, " or alarm posts, against inroads by land and " notably by sea. Their name, and their being " often met on the sea-shore, lend colouring to " the latter hypothesis, which is further strength- " ened by the area they sometimes occupy, the " Colona specchie, between Lecce and Otranto, " measuring 257 metres at the base, whilst the " best preserved side is still 17 metres, *e.g.* the " exact dimensions of agglomerated núraghs." †

It is only lately that I have had the chance of reading M. Perrot's book, which deals with this subject, and caused me to return to my old sketches and notes. The references given add many details with which I had no opportunity of becoming acquainted while passing in a railway train. The references show the various purposes to which these buildings were applied, and they assume that they are descended from the ancient núraghs. M. Perrot considers that, as the heel of the boot of Italy was an outlying district, the type was persisted in, and has come down to our own days " with no appreciative change;" while, in the towns and villages, the architecture and mode of building underwent the usual influences which time produces.—WILLIAM SIMPSON.

* *History of Art in Sardinia and Judæa*, vol. i. p. 48.
† *Ibid.* vol. i. pp. 48, 49.

"London and its Council" [p. 271].

From ARTHUR CAWSTON [*A.*]—

" London reformers were laughed at five years " ago, they were hated and abused three years " ago, but to-day they are so powerful over the " mass of London voters that there is hardly a " Metropolitan Tory in the House of Commons " who does not feel compelled to disclaim any " intention to oppose them." So wrote *The Speaker* on February 24th. It is doubtful, however, if even the progressist writer of that paper realised that during the same month the son of the late great individualist—George Edmund Street—had penned such a paragraph as the following:—" It would be better, even, that the " liberty of the subject should be interfered with, " than that new Regent Street should be another " Shaftesbury Avenue" [p. 273].

Up to the present time the bugbear to the progress of municipal government has doubtless been our boasted and over-rated individualism. Now, if so influential and talented a writer as Mr. A. E. Street, M.A., advises that London—that happy land for architectural freedom and freaks—would be the better for adequate municipal control, London reformers have indeed found a powerful supporter where they may least have expected it. But was Mr. Street judicious even to imply that Regent Street is superior to Shaftesbury Avenue? Knowing, as he must know so well, the jealousy that still exists among Londoners for their freedom from control, and the suspicion with which anything like " soulless, " slavish regularity" or " feeble imitations of " early Parisian Boulevards" is regarded, surely it would have been more politic to have named one of the picturesque new streets on the Westminster or Cadogan estates, instead of the so-called monotonous Regent Street.

The transformations on the noblemen's estates referred to have proved to us that it *is* possible to so control the rebuilding of London as to make it healthy, convenient, and, at the same time, more picturesque than ever it was before. I even go so far as to assert that the general appearance of these estates far excels that found in any Continental city that I know.

These few words as an introduction to the following serious question:—What should be the attitude of the Institute towards the London Building Act, 1894? Should the Institute consider the Bill solely from the lofty standpoint of would-be reformers of London's architecture, or from the lower standpoint, and in the interests of our individual clients, the London freeholder and leaseholder?

Delighted that London at last possesses a representative body anxious to press forward the aims of the Institute, I am unhesitatingly of opinion that we should adopt the attitude of London reformers, and for this simple reason: The Institute exists for the sole purpose of advancing the art of architecture, and it is the recognised body of experts interested in the architectural improvement of London.

I submit, therefore, that the Institute should consider this Bill mainly from the point of view of the architectural improvement of London, and,

if it is necessary for such improvement that our authorities should make owners set back their houses (as has been done on the noblemen's estates above referred to), the Institute should advise accordingly, and not qualify such setting back by the question of payment or non-payment of compensation for the land surrendered to public uses. Monetary questions such as these are sure to form sufficient impediments to progress, and to be fully considered by the House of Lords, the House of Commons, and the Surveyors' Institution, neither of which bodies seems to care in the least for the grand art it is our privilege to represent.

If, therefore, we wish to render that assistance to this herculean task which will prove the most valuable at the present moment, we must pass over monetary questions to surveyors. We must stick to our last, and, after studying the transformations that have taken place on certain London estates and in other cities, submit to the L.C.C. such alterations to their proposed Bill as we consider essential to effect the adequate improvement of our neglected metropolis within a reasonable limit of time.

The following considerations occur to me as being worthy of bearing in mind when discussing certain clauses of the proposed Bill :—

Is it essential for health, convenience, or beauty that the same laws should apply to the City proper, and other commercial centres, as apply to our residential suburbs?

Is it reasonable that a certain proportion of each site for dwelling-houses should be left uncovered? In Berlin two-thirds only of sites recently acquired may be covered with buildings; whilst on old sites three-fourths of the surface may be covered. In Vienna 85 per cent. of sites may be covered.*

Is it reasonable to attempt to so curtail building sites in London as to obtain adequately wide thoroughfares, and the same amount of light and air to back and side windows as to front windows? In Paris, where the roadways are none too wide, one-third of the whole area of the city is devoted to boulevards and other public open spaces. We all know that the back windows of the Parisian flats are not so airy as those in front. If, therefore, we in London attempt to provide the same amount of light and air to our back windows as to the front, and to provide in addition streets for our heavy traffic as spacious as those of Paris, the amount of our building land would soon be reduced to one-third of the whole area, whilst two-thirds would become open space!

Party-wall Parapets.

From W. D. Caröe, M.A. Cantab. [*F.*]—

In the consideration of any revision of the Metropolitan Building Acts, it is obviously desirable for Londoners to study the regulations and practices of the great provincial towns, and to glean hints for their own advantage from usages which have proved themselves efficient, although differing from those to which they have been accustomed. The fact that the corporate authorities of the North of England, with remarkable consensus of opinion, find themselves able to do without party-wall parapets in dwelling-houses may well make us pause before granting a new lease to a custom which has been the cause of much expense and bad construction to Londoners, to say nothing of its inherent unsightliness. This is not a question in which arguments based upon theory alone—or upon prejudice—should have any weight whatever. It is sufficient to know that many years of practical experience in great cities have proved party-wall parapets on domestic buildings to be altogether unnecessary. With the alternative method adopted in the North, which dispenses with such parapets, the fire risks are proved to be no greater; while the gain, both in construction and economy, is apparent.

I am able to publish in his own words the views of one of the leading experts and authorities of the great cities of the North. I would also draw attention to his concluding remarks upon "separate side walls"—a most workable provision in regard to the separation of adjoining properties in towns, which encourages owners to build entirely upon their own site, with obvious gain in the saving of differences, disputes, discomforts, and litigation. Here follows the communication from the authority referred to :—

——, *15th February* 1894.

My reasons for preferring that party-walls should be carried only up to the roof covering and not through the roof are :—

(1) That as a matter of construction, better work is more usually done in the former case, so that the roof is more perfectly weathertight than when the wall is carried above the roof.

(2) That the object of carrying the wall as a parapet—namely, the prevention of the spread of fire—is sufficiently accomplished by lining the party-wall close up to the slates, except, of course, in the special cases of warehouses or other buildings where great fires are liable to occur.

(3) The building of a parapet wall, together with the necessary flashing and coping, and in many cases corbelling, at the foot of the parapet, involves considerable additional expense, which in the case of ordinary houses causes an increase of rent without, in my opinion, any corresponding advantage in any way.

With regard to the view which the Fire Brigade authorities take of these questions, I send you herewith two printed lists, prepared by the Salvage Committee, showing the number of fires which have taken place in the city and neighbour-

* See *A Treatise on Public Health.* By A. Palmberg. (Swan Sonnenschein & Co.)—A. C.

hood during the two years 1891-92, and showing also the causes of the fires.

Since receiving your letter I have seen the chiefs of the Fire Brigade and the Salvage Corps on the subject, and they tell me that in their experience they have never known any harm to result from the want of a party-wall carried up through the roof in ordinary buildings other than those of the warehouse class, and that they see no necessity whatever for a provision requiring such a wall in those cases.

My own personal opinion quite coincides with that of the fire officers. One chief reason for saying this is, that in the case of every fire within this city I have sent to me an official report, at some length, from the Head Constable, who is also the head of the Fire Brigade, stating full particulars of the fire, its origin, its extent and progress, and during my nineteen years' experience in this respect I have never received any impression that the want of a party-wall carried up as a parapet above the roof had contributed to the spread of a fire.

With regard to "separate side walls," so called in ——, I am of opinion that our regulation which requires that where adjoining owners do not agree to build one party-wall separating two buildings they must each build an independent "separate side" wall on their own ground is a very good one, and works beneficially to the owners of property, and also acts as a preventive against the spread of fire. It is obvious that where there are two separate side walls alongside each other the risk of fire passing through one building to another is less than when there is but one wall (a party-wall) to receive the timbers of the two buildings. It is equally obvious, I think, that many causes of dispute and litigation with regard to the rights of adjoining owners are avoided where two walls are thus built instead of one.

You are aware that in this city a "separate "side wall" is allowed to be built of a thickness equal to only two-thirds of the thickness required for a party-wall or external wall. This slight concession as to thickness (compared with the metropolitan requirement) has the effect of inducing architects and owners of property to erect separate side walls in many cases where they would not do so if the full thickness required for a party-wall were insisted on in such cases, and it is found that the thickness of two-thirds is usually sufficient for strength and stability, considering that the thickness must be continuous without break or recess, and that the separate side wall has to carry the weight of floors and roof on one side only. Of course, if in any special case the thickness of two-thirds allowed by the regulations should appear likely to prove insufficient for extra strains from heavily-loaded floors or otherwise, the architect or builder would provide internal piers at intervals so as to increase the thickness of the wall, in places, beyond what is required by the regulations.

You may take it from me that there is no desire or intention in this city to alter the regulations with regard to the points above referred to.

Betterment, Worsement, and Recoupment.

From William Woodward [*A.*]—

At the time the subject of "Betterment" was before the House of Commons no speaker evinced a sounder acquaintance with the practical working results of the L.C.C. scheme than Mr. Arthur Baumann, then member for Peckham. Mr. Baumann has followed up his spirited attack on the unfair proposals which issued from Spring Gardens by equally spirited letters addressed to *The Times*, and in a little book which he has just put forth the whole case of "Betterment"—and its probable companion "Worsement" (which the L.C.C., somehow, have never been able to see)—is clearly dealt with by one who really is entitled to speak upon the subject. Mr. Baumann shows that opposition to the scheme is not because there is a desire on the part of anyone that a man whose property is increased in value by improvements carried out at the public cost should not contribute to such cost —that contribution is already levied by increased assessment; but what is further asked by the L.C.C. is that, in addition to that increased assessment, there shall be a special rate levied on those "owners" whose property fronts some improved thoroughfare, or is within what the L.C.C. are pleased to designate a "Betterment Area." But even to this latter proposition there can be no real objection so long as it is undisputed that the property so specially rated has unquestionably directly benefited because of the public improvement. Then comes the pertinent question, which I have never yet heard candidly answered by the L.C.C.: Who is the "owner" who is to be called upon in the first instance to pay this general rate? Take the case of a freeholder in receipt of a ground rent for seventy years to come at £25 per annum, a building leaseholder with the seventy years unexpired at £25 per annum, and a sub-lessee and occupier with thirty years unexpired at £150 per annum. From which of those three persons is it proposed that the first contribution towards the admitted "Betterment" be demanded, and for what period is the contribution to be continued? If these questions were fairly answered I venture to think that the whole structure of "Betterment," as erected by the L.C.C., would totter to the ground.

Mr. Baumann's remarks on "Worsement" are to the point, and he quotes Mr. Charles Harrison, who shows that the "Recoupment" principle in

* *Betterment, Worsement, and Recoupment.* By Arthur A. Baumann, B.A., Barrister-at-Law. 8o. Lond. 1894: Stanford, Cockspur Street, S.W.

street improvements proper has been not only not profitable, but in many cases a positive loss. But Mr. Baumann points out that this "Recoupment" would have been different had a part of it not been "intercepted" on its way to the public pocket by individuals in the employ of the late Metropolitan Board of Works, and he urges, with much reason, that "Recoupment" is a fair and business-like method of dealing with public improvements.

Mr. Baumann concludes his book by a "Note "on Betterment in America;" and I recommend all who desire to obtain a grasp of the principles underlying proposed "Betterment" in London to study his handy and terse little volume.

Ambrose Poynter on Iron Construction.

The subject of iron construction, and the possibilities which exist for the more extensive utilisation of the metal in place of stone and marble in the adornment of our buildings, touched upon by Professor Aitchison in his first Academy lecture, was dealt with at considerable length in the lecture of the 5th ult., a few extracts from which are given on another page, but which may be read in its entirety in the columns of *The Builder*. Very noteworthy in their bearing on his subject are the passages quoted by the Professor from the Essay "On the Effects which should result to "Architectural Taste with regard to Arrangement "and Design from the General Introduction of "Iron in the Construction of Buildings," which gained the Silver Medal of the Institute as long ago as 1812. The author was the late Ambrose Poynter, the architect. The Essay in question was published in *The Civil Engineers' and Architects' Journal*, long since defunct, but the pages containing it are bound up with other Essays in a volume in the Institute Library. The following are the passages quoted by the lecturer:—

Whether we contemplate the architecture of the Egyptians or the Greeks, the stupendous piles of the Eternal City, the gorgeous monuments of the Gothic style, the mazy intricacy of the Alhambra, or the finished productions of modern Italy, the mind perceives in each and all the adaptation of the means to the end, and the development of the spirit of the age and country in which, and for which, they were created, and these form the essential principle of the relative beauty of architecture. Now, where shall we turn to find the beauty born from the spirit of our age and country in the architecture of the nineteenth century? The very proposition at the head of this paper is an answer. In the nineteenth century we are in possession of a material in extensive operation, offering us new modes of construction, new proportions, the power of creating new forms and combinations, differing from everything that has preceded them in art.

It is now sixty-two years since the erection of the bridge at Colebrook-dale first revealed the capabilities of cast iron in construction on a large scale; and during that period science and cast iron have marched, hand in hand, with strides it is amazing to contemplate. But what has *art* effected with this new power? The Institute of British Architects are still at the enquiry "what effect should "result to architectural taste from its general intro- "duction?"

In the real adaptation of cast iron to architecture as an art, we are much where the Dorians were when they had placed four trunks of trees in a row with a tile upon each. There the Doric order might have remained had the Dorians been of our stamp, and there it would have remained had trunks of trees instead of cast iron been first used in construction in our time. Or perhaps the parallel will run closer if we compare ourselves with the ancients, when they first adopted the principle of the arch, since they combined it with architectural forms already established; as we shall probably seek to do with cast iron whenever we begin to bestow our attention upon it. After sixty-two years' experience, under circumstances through which a new and original style of architecture might have been developed, we are still where the Romans may have been when they built their Cloaca Maxima.

To what are we to attribute this stagnation in all our ideas as regards art in this point of view? Doubtless to the blind spirit of imitation and obstinate adherence to precedent (whether applicable or not seems of little importance) which characterises the architecture of the present day. Where cast iron is to be used, the first requisite seems to be to keep it out of sight, or to make it look as much as possible like something else. To impress upon it the character of a style would be more in the spirit of the ancients, whom we profess to adore.

Not that it is in the power of any man to stand forth and say, "I will invent a style." A style, like a language, must be the growth of time and circumstances; and who is to make the first essay in an age when precedent is "the be-all and the end-all," and when he who cannot command success cares not for the higher distinction of deserving it?

The fatal effect of this spirit on our architecture might be evidenced in various ways. What has been advanced on the subject of cast iron is very far from being the strongest point in which it might be shown, but the argument must be limited to the question under immediate consideration. It may, perhaps, be further illustrated by a *reductio ad absurdum*. Let us suppose that the Greeks had possessed no marble, but had known the art of casting large weights of iron, and had thought proper to use it "with regard to arrangement and design," as it *might* have been used in their hands; we will further suppose that the art had been lost; we should, perhaps, still have looked upon the monuments of antiquity so designed and constructed in the same vulgar spirit with which it has been the fashion to contemplate the Parthenon—as something to be imitated. How would our "genius have been "cramped!" as the phrase is. How should we have lamented at finding ourselves restricted to the use of stone or marble, in which we should have sought in vain to reproduce the light forms of antiquity!

Instead of striking out original proportions and combinations adapted to our means, we should sit down perfectly convinced that neither beauty nor character could be created under the disadvantage of such materials, and abandon ourselves in despair to the construction of bare walls, the monotony of which might now and then be relieved by the crash of a public building, through the laudable attempt of some *classical* genius to support it on Bath stone columns five-and-thirty diameters high.

One cannot but agree with Professor Aitchison that this question of iron construction is a very important one, and merits the earnest consideration of architects; and members are invited to discuss the pros and cons of the subject in the columns of the JOURNAL.

9, Conduit Street, London, W., 1 *March* 1894.

MINUTES. IX.

At the Ninth General Meeting (Ordinary) of the Session, held on Monday, 26th February 1894, at 8 p.m., Mr. J. Macvicar Anderson, *President*, in the chair, with 22 Fellows (including 2 members of the Council), 18 Associates (including 1 member of the Council), 1 Hon. Associate, and several visitors, the Minutes of the Meeting held 12th February 1894 [p. 277] were taken as read and signed as correct.

Pursuant to notice duly given, and in accordance with the provisions of By-law 40, it was, on the motion of Mr. Wm. Woodward [*A.*], seconded by Mr. H. W. Burrows [*A.*],

Resolved, that Mr. F. W. Marks [*A.*] be elected Associate-Auditor in place of Mr. G. A. T. Middleton [*A.*], who had resigned the office.

The President announced the results of the Intermediate Examination held on the 20th, 21st, and 22nd February 1894, and read the names and addresses of 21 Probationers [p. 308] who had passed, and were registered as Students.

Papers on The New Engineering and Physical Laboratories at University College, London, by Professor T. Roger Smith [*F.*], Professor J. A. Fleming, M.A., D.Sc., F.R.S., Professor G. Carey Foster, F.R.S., and Professor T. Hudson Beare, B.Sc., M.Inst.C.E., having been read by the first named, and discussed, a vote of thanks to the authors was passed by acclamation. Professor T. Roger Smith responded, and the Institute adjourned at 10.15 p.m.

PROCEEDINGS OF ALLIED SOCIETIES.

GLASGOW SCHOOL OF ART.

The Architecture of the Italian Renaissance.

The sixth lecture of the series by Mr. William J. Anderson [*A.*] was delivered on Wednesday, the 14th ult., in the Corporation Galleries, in connection with the Glasgow School of Art. In continuation of the subject of the last lecture, "The Culmination of the Renaissance," its effects in Venice and the North were discussed, and were shown to be directly the result of Roman education and bias on the part of its architects. The Lombardic school preceded this central Roman period of Sanmicheli and Sansovino, which is represented best by the gateways and palaces of Verona, the Pal. Grimani, and the library of St. Mark at Venice. Sketches of the lives and works of three of the leading architects of the culminating period—Peruzzi, Sanmicheli, and Jacopo Sansovino—were given. The most numerous works of the first named are at Rome, and best exemplify what the Roman influence amounted to; and at Siena, Bologna, and Ferrara excellent examples exist. Most of these were fully illustrated, as were also the works of his equally able contemporary, the Veronese.

LEICESTER AND LEICESTERSHIRE: PRIZE DISTRIBUTION.

On the 22nd ult. the prizes recently awarded in the Students' Competition were distributed at the Wyggeston Boys' School by the invitation of the Rev. James Went, M.A., the Head Master. All the drawings submitted to the Committee were exhibited on the walls. Mr. A. H. Paget [*F.*], the President, was in the chair, and, having opened the proceedings, called upon Mr. S. Perkins Pick [*A.*], the Honorary Secretary of the Society, to read a Paper upon the work submitted by the students. This address contained most instructive criticism of the drawings of each competitor, in which the strong points were praised, and the shortcomings, resulting from misdirected industry and want of knowledge of the best methods, were pointed out. The President then gave prizes of books on architecture and building, selected by each recipient, to the following students:—First prize for measured work, to Mr. Albert Herbert, for drawings of the great south aisle of St. Martin's Church, Leicester; second prize to Mr. J. Clark, for drawings of local work of the last century, including a fine pair of wrought-iron gates at Belgrave, Leicester; extra prize to Mr. J. F. J. Goodacre, for drawings of St. Nicholas' Church, Leicester. A prize for architectural sketching was presented to Mr. J. S. Harrison for pencil sketches of Rievaulx Abbey. A vote of thanks to Mr. Pick for his judicious and sympathetic criticism was moved by Mr. H. W. Roberts and seconded by Mr. J. Goodacre [*F.*]. Thanks were also accorded to the Rev. J. Went, on the motion of Mr. H. L. Goddard, M.A. [*A.*], seconded by Mr. W. A. Catlow, and to the President, proposed by Mr. Councillor Wakerley, seconded by Mr. A. H. Hind [*A.*]. A number of mounted drawings and sketch-books lent by the President, Mr. Fletcher, Mr. Pick, Mr. Hind, and Mr. H. L. Goddard were exhibited at the meeting, and it was announced that these would remain on view during the two succeeding days.

YORK: SESSIONAL MEETING.

On Thursday 22nd ult. the York Architectural Society held the Third Ordinary Meeting of the Winter Session, by special permission of the York Corporation, at the Courts of Justice, Mr. W. Hepper, the President of the Society, in the chair. A lecture was delivered by Mr. J. T. Pegge, P.A.S.I., on "The Lighting of Dwelling Houses "by Electricity, and its Uses for Domestic Purposes." The lecturer described electricity, giving the synonymous terms applied to a "current of electricity" and a "flow in "water," a description of the parts constituting the most elementary form of dynamo, all the production of electricity by dynamos and batteries, and the storage by accumulators.

The advantages of this light over other artificial lights were held to consist in—

The adaptability to any position for temporary or permanent use, and, from a commercial point of view, the impetus given to the art metal-working industry in producing highly artistic fittings in almost endless variety.

The comparative immunity from risk with a properly controlled and *fused* system.

The ease with which the system can be efficiently laid in and tested.

The almost automatic character of most of the fittings.

The non-consumption of oxygen, with its corresponding vitiated atmosphere.

The use of portable lights or temporary installations of low voltagefor "at homes," conversaziones, bazaars, &c., &c.

The convenient attachment of lamps, and their long life (averaging two or three years on a circuit running at a potential of little variation).

The production of a steady and uniform light, unaffected by draughts, &c.

The next question dealt with—that of cost—was illustrated by taking the case of a supply for a whole town served in a similar manner, light for light, by gas. On the basis of Mr. Preece's figures, viz., gas at three shillings per thousand cubic feet is equal to sixpence per unit, the lecturer argued that, with gas even less than three shillings per thousand feet, sixpence per unit for electricity is by no means excessive, considering—

The saving on account of improved health and eyesight.

The lessened depreciation in house and shop furniture and decorations.

The convenience of control and the beauty of the light.

The lecturer drew attention to the use of the current for motive power—the great economy and portability of motors are such as to render their use for household purposes certain to develop in course of time—also the marvellous extension in the use of electricity in telephony, bells, &c.

The advantages of cooking with electric cookers were held to be such as would commend their use even in lieu of fires, particularly for four or five months in the year; it is a boon to the housewife to be able to "turn" on the electric cooker and be able, within fifteen minutes, to have a heat of four hundred degrees Fahrenheit, when the current may be shut off, and in a couple of hours' time there is still a good margin above boiling point to work with. Contrast this with the immediate dead loss in smoke and vapour of at least fifty degrees of the heat-giving properties of coal—or, in the case of a gas stove, the burners must be kept alight up to the last quarter of an hour, with the probability of an offensive product of combustion into the room, and the vitiation of the air due to the fouling of the burners and the stove pipe—and you have only rendered more plain the advantages of electrical cooking if even at slightly additional cost. In the case of heating:—Stoves, &c., may be carried from room to room and connected up to wall plugs, and used with such ease, cleanliness, and certainty of action as to leave no doubts on the score of their merit or economy.

The lecturer terminated with a general outline specification, covering an installation for a large building. The paper was practically illustrated by switching "the light" in and out of various fittings, and by the use of electrical cooking apparatus.

THE ROYAL ACADEMY OF ARTS.

The Advancement of Architecture.

Professor Aitchison's course of lectures on the Advancement of Architecture terminated on the 15th ult. A few extracts from the third, fourth, and fifth are here given:—

When an architectural student has made himself familiar with the forms of some past style, or styles, it seems delightful to him, if he has invention and skill in portrayal, to sketch out the view of a church, a palace, or what not. . . . What, however, can be more opposed to these aërial visions of beauty than the arrangements for meeting wants, propriety in the use of materials, geometrical proportions that are dry matters of calculation, and the mathematical formulæ of statics? . . .

Sta. Sophia and St. Peter's may be cited as examples of imperfectly-designed work, causing continued outlay and anxiety from their first building, owing to the incomplete knowledge of the architects. . . . One of the great causes of our admiration of Gothic structures is their novel daring in construction, and this was gained by a practical acquaintance with the strength of stone, and the thrusts of vaults, and a desire to surpass former achievements; if we want to rival them, we must have at least the preliminary knowledge. The exact strength of most materials has been ascertained, and the engineers have applied, to utilitarian purposes, this knowledge of iron in the most marvellous way, and when the architects have acquired the knowledge they will also have to apply it for emotional purposes as well. . . . It is mere pedantry, if not incompetence, that makes us use old forms of construction that we should never think of using in a building for purely utilitarian purposes. Our business is to learn how to make our commonplace construction also answer for the effects we want to produce; this end is to be achieved by study and by effort. You may go to an engineer, and get him to make your hidden ironwork strong enough for its purpose; but directly you have to make your ironwork sightly or beautiful, and are ignorant of the laws of construction and of the qualities of the material, you must either be guilty of immense waste or give it up. . . . The modern student has an instinct that no living is to be made out of ornamental cast-iron work, so he utterly refuses to make any attempt in that direction. This is a pity, for though architects may never gain a living by designing ornamental ironwork, it is a fine opportunity for the exercise of invention, as it is untrammelled by precedent, and if the capacities of the material are not infringed, there is nothing to prevent beauty being bestowed on it, except want of ability in the designer. . . . A considerable field for the exercise of his profession is taken from the architect and handed over to the engineer; all iron and most stone and brick bridges have been so transferred, for the simple reason that architects decline to study construction, so that in the eyes of the public the architect and engineer carry on the same profession, but the engineer is a man of larger mind. . . . There is one point that is generally overlooked in speaking of the necessity of studying statics: Vitruvius says (Lib. iii. cap. 1): "Symmetry arises from proportion, which the Greeks "call ἀναλογία. Proportion is a due adjustment of the size "of the different parts to each other and to the whole; "on this proper adjustment symmetry depends. Hence "no building can be said to be well-designed which wants "symmetry and proportion." Hitherto this proportioning of the parts to the whole has had to be got by arbitrary methods, that is to say, we have to study the proportions of the grand antique buildings which have charmed us to get it, and certain rules have been given us by Vitruvius; but, as our buildings are for such varied uses, and in some respects so different from the antique examples, the precedent of time-honoured proportions has failed us, particularly in those parts which perform some important structural function. Now statics will give us this necessary symmetry, using the word in the Vitruvian sense and not in the modern one, as far as the structural parts are concerned; and nothing else will do it properly; for, if the buildings to be erected are of a different size from those that have furnished us with the proportions, the parts of a smaller new building will be as much too massive as those of a larger one will be dangerously slight. Even if we are most concerned about the appearance of our building, we could not make its parts slighter than safety admits, however light we wish our building to look; and if we wish our building to be more massive than necessary, nothing could give us the relative sizes better than to add a uniform percentage to each part. One of the commonest faults we meet with in modern buildings is a gross disproportion between what is to be carried and the carrying part. To speak of one feature only. We constantly see balconies with cantilevers big enough to carry the house. . . . It seems ridiculous to have to insist on the importance of statics when civil architecture is a constructive art whose productions, buildings, are wanted to stand securely, without extraneous help. The science of statics is defined as "the effects of forces on solid bodies at rest," and a building is always wanted to be at rest. The main forces that are brought to bear on a building are the gravity of the materials used in its construction; and these materials, when in the form of inclined beams, as in roofs, or of the wedge-shaped pieces in arches, vaults, and domes, tend to overset the parts they abut against. There are also the extraneous loads put into them, which sometimes have a thrust of their own as well. The pressure of the wind, and the vibration caused by it, and the weight of snow are external forces that act in the same way, and occasionally, though rarely, the mechanical forces of water, ice, and fire.

One must never forget that, among the many causes that produce the requisite effects in architectural buildings, those caused by statical considerations are important factors,

and in a few cases by far the most important. One can hardly deny that raking shores to a wooden building, when the roof is not tied, form an important feature; and so does the system of stone shoring, which is composed of buttresses and flying buttresses. The devices resorted to for the abutment of domed structures also give a marked character to such edifices.

Although construction is the master art in architecture, it brings to the architect neither fame nor reputation, not even recognition. . . . Yet if the smallest defect be found in the construction of a building, to speak at present of nothing else, the owner will then be awake to the fact that the building was not self-created, and woe betide the architect who has committed so unpardonable a sin! So I must strenuously urge you to learn as much of the science of construction as you can. . . . Every architect should know how to calculate the strength of a column, a girder, and a truss, the conditions of stability of a steeple and a wall against the wind, if not of the latter against earth and water, the thrusts of an arch, a vault, and a dome, and the pressure of water in large cisterns, or he may have a most serious disaster. Nor need you be ashamed of some tincture of science, for in the "Arabian Nights" the architects are always called geometers or mathematicians. It is because architecture requires such vast and conflicting attainments that it is one of the master arts, and that great architects are much rarer than the black swan.

EXTRACTS FROM THE FOURTH LECTURE.

We cannot study Greek work too deeply to refine our perceptions, to see how common things can be shaped into beauty, to learn to love simplicity, to learn how to take the same endless pains the Greeks took in adapting our buildings, and every part of them, to this climate, to learn due proportioning, which gives undying beauty, and to see that each part is proportioned, not only to harmonise with every other part, but also to secure the due proportioning of the whole. The Gothic architects, like Vitruvius, and probably from him, took the human figure as their scale; when we have thoroughly studied Greek work we should then try and apply the lessons learnt, even if we only try to make a cast-iron girder and a stanchion as beautiful as a Greek architect would have made them. I do not even object to direct appropriation of a piece, for, if we can use it properly, it becomes a quotation. The poets have no qualms of conscience in this respect. Keats' "A thing of "beauty is a joy for ever" is from Euripides, and almost every great poet borrows from the antique, and from his predecessors. We are, however, not Greeks of the fifth century B.C., and cannot have their identical tastes and desires. We could not be Greeks if we would, and I would not be a Greek if I could, supposing De Quincey's verdict to be true—that they were a nation of swindlers. The Greeks were pre-eminently artists, and from them the civilisation of Christendom has come. The Romans, on the contrary, were not only inartistic, but almost to the last decried, if they did not despise, all the fine arts but eloquence and poetry. In other respects they were a greater people than the Greeks. They were a hard-headed, practical, straightforward, honest people, who knew how to obey as well as to command, until they were corrupted by power, wealth, and luxury. They had, too, a natural gift for construction, which the remains of their buildings in every part of the world amply show. Directly they became acquainted with Greek architecture they not only felt they were in the presence of their masters in æsthetics, but saw no better way of rivalling them in architecture than by taking their work bodily. You must remember that the living Greek architecture of Roman days was not that of the time of Pericles and Phidias, but the debased architecture of the Macedonian barbarians and of Sicily. The Romans are supposed to have got the arch from the Etruscans at an early period of their history, and they were much too practical a people to overlook so useful and economical an invention; it was a new advance in statics, and did not æsthetically harmonise with the Greek post and lintel. To the Romans the post and lintel was art, so they used it where they could for temples and for their grand public buildings, while for all practical work the arch was used, the column and pilaster being looked upon as signs of art, whether they were wanted or not. The Romans tried to amalgamate these two methods of building as much as possible. No better illustration of this can be offered than their triumphal arches. At some period after Vitruvius's book was written the Roman method of building with rubble, faced with triangular bricks, was introduced, as well as the making of a light framework, with rectangular bricks, for the rubble of arches, vaults, and domes, so that there was no sort of building the Romans could not execute. Their requirements were such that much more elaborate plans were wanted than those we find in Greek remains, and their buildings were of much greater altitude, the Greek public buildings being mostly of one storey, or, if of more, the storeys were comprised in the height of the one external order. To attain altitude the Romans piled a series of buildings one on the other, each making a storey, and each storey having a complete order of columns or pilasters and their entablature, but with arched openings between the columns. The column, except for porticoes and peristyles and for decorative purposes, gradually became confined to one use—*i.e.*, to support groined vaults—but, as if to show its former use, they left a slice of entablature over it until the days of Diocletian (A.D. 284–305), when the slice was left out and arches sprang direct from the capitals of the columns; so that we may say that Roman architecture, as a style, was the struggle between the arch and the lintel as to which should get the mastery, and it was not until Byzantine days that the arch finally got the upper hand.

EXTRACTS FROM THE FIFTH LECTURE.

Italy from the thirteenth century seems to have been singularly wanting in architectural schools. The Gothic, brought by French and German architects, was used in Italy mainly as decoration, except at Milan, which seems to have been wholly in artistic dependence on Germany. No really organic Gothic is to be found in the upper part of the peninsula, some form of Byzantine, Romanesque, or decorative Gothic being mostly used to the end of the fourteenth century. . . . After the invasion of the savages, and during the dark ages, besides having to nominally convert the conquerors, the clergy had to try and infuse into these ferocious, bloodthirsty, and brutal savages some respect for law, order, and industry. The liturgy and the Bible being in Latin, the grammar could not be properly taught without examples from the poets, orators, and historians; and these, as well as the works of the Roman lawyers and the classic philosophers, were necessary for the teaching and mental enforcement of law and order, so that we find Dante speaking of most of the Latin authors and of the principal Greek poets and philosophers. The works of such Greek authors as were known were translations into Latin of the Arabic versions. . . . Dante had seen how superior the Latin classics were in style to the works of mediæval writers, and adopted Virgil as his guide in poetry. Niccola Pisano, the architect and sculptor, who died when Dante was a boy, had made the same discovery in regard to sculpture, *i.e.* that Roman sculpture was very superior to mediæval carving, and had adapted the figures from a Roman sarcophagus and vase for his pulpits. . . . It is necessary to say something about Vitruvius, as his work had great influence; every scholar thought Vitruvius contained the recipes for this fine Roman architecture, that all were bound to admire. Professor Cockerell

believed that Vitruvius was known and studied during the whole of the middle ages. He says: "The church in the "castle of Nuremberg, built by Barbarossa in 1158, and "the Fraumkirk in the centre of that great city, probably "of later date, are exact illustrations of the 'Temple in "'Antis' of Vitruvius, as given by Cæsariano" (Lib. 3, fol. 52).*. We see from Cæsariano's cuts and annotations that the mediævals had applied Vitruvius's classification of the temples from the outside to the inside, so that a decastyle temple was a church with ten pillars to the nave, a dipteral temple had two aisles, and a pseudo-dipteral an aisle of double the usual width. I believe the codices of Vitruvius now known are of the ninth, tenth, eleventh, and twelfth centuries. An unbound MS. volume of Vitruvius is mentioned by Beccadelli as belonging to him, and when Alphonso "the Wise," who was going to trust entirely to Vitruvius for the additions he was about making at Naples, received the leaves, he made the celebrated remark, "It is not becoming that this important book, which "teaches us so well how to cover in ourselves, should go "about uncovered." Beccadelli lived from 1394 to 1471. The Editio Princeps of Vitruvius is without title, place, or date, but is believed to have been printed by G. Herolt, and published in Rome about 1486; it was edited by Sulpitius from a codex found by Poggio Bracciolini at St. Gall about 1414. The concurrent circumstances of a passion for style, beauty, and delight, for intellectual freedom, and for the study of the classic authors turned the thoughts of Italians towards Rome.

Architecture got into the hands of scholars, antiquaries, goldsmiths, painters, and sculptors, and became, as Michelangelo called it, a branch of the art of draughtsmanship. The belief that the architecture of Rome was perfect certainly held full sway in the civilised world until 1768, when Milizia published *The Lives of Celebrated Architects.*

Florence, which has been called the modern Athens, and was said by Boniface VIII. to be the fifth element, was the natural place for new views on everything to spring up, including the fine arts. The probability is that Brunellesco, having gone to Rome to pick up something about domes, was so much struck by the style and dignity of the Roman remains as to induce him and his companion, Donatello, to measure them. On Brunellesco's return to Florence he naturally advocated a return to Roman architecture, but had this accident not happened it could only have retarded the movement by a few years. . . .

The fame of the discovery of an ancient codex of Vitruvius by the Papal Secretary must have awakened a new interest in the work, though there were possibly a few MS. copies about. Vitruvius being printed at Rome must not only have made it more accessible, but more talked about, and have thus drawn attention to the fact that in it were to be found the recipes for the manufacture of that architecture so much admired by all men of taste. We must recollect that, as there were no schools of architecture, painters or sculptors who had been employed on buildings were thought fit to be architects. . . .

Rabelais' book of Gargantua and Pantagruel is a ribald one; but, as far as I know, it alone gives some notion of the feelings of mankind at the Renaissance, and that, too, without the darker traits of Italy. You must read the "Murderous Machiavel" for that; however, J. A. Symonds' work on the Renaissance is enough for most of us; and for the graver side of learning, Milton's poems give us some idea of the variety and vastness of the attainments at the Renaissance. The idea was this, that there were to be great intellectual cultivation and curiosity, great splendour, great personal achievements, and great enjoyment, but the only law was to do what one best liked, which was to result in perfect happiness. What it did result in, in too many cases, was a return to the worst vices of paganism, in which distinguished men too often indulged, almost without a reproach. . . .

Antique Roman work was considered by the Italians of the early Renaissance as perfect, and to be imitated; for you must recollect that the Renaissance architects were not architects according to our view; but were sculptors, painters, or goldsmiths, who wanted to make the exterior of their buildings agreeable, and were, therefore, not shocked by any kind of structural absurdity. With them columns did not represent a purely constructive feature made beautiful, but were looked upon as beautiful and convenient things for cutting up a surface. This view is even now hardly extinct, and was in full vigour up to a comparatively recent period. Many of our public buildings, and perhaps even more of our grand corporate and private buildings, have the appearance of being built within the colonnades of ruined temples; and it is fortunate when the temple stands on the ground, and is not raised on a lofty basement, which takes away the very semblance of reality, and shows the pure folly of the proceeding. There are excuses to be made for these vagaries among nations and in times when sculpture was unknown, or was in such a debased state that it could produce no emotion, and was like rude early sculpture, really used as picture writing to tell a story. But we now have admirable sculptors who could tell us all the emotional stories of the past, and convey to us every perfect form of human beauty. They cannot, of course, express any stirring incident of the present day, because our clothes not only blur all form in repose or action, but are in themselves too ignoble to raise anything but laughter or contempt. I consider it a most despicable attempt at ornamenting a building in the present day to cover it with useless columns, blind arcades, or common geometrical forms, when it had much better be left plain if fine sculpture cannot be afforded to enrich it. There was something to be said for the geometrical patterns of the Saracens, for they not only appear to be insoluble, but the Moslems were discouraged from using figure sculpture.

John Addington Symonds, after stating that the Renaissance architecture created a new common style for Europe, makes the following prophecy:—

"With all its defects, it is not likely that the neo-Roman "architecture, so profoundly studied by the Italians, and "so anxiously refined by their chief masters, will ever "wholly cease to be employed. In all cases where a grand "and massive edifice, no less suited to purposes of prac- "tical utility than imposing by its splendour, is required, "this style of building will be found the best. Changes of "taste and fashion, local circumstances, and the personal "proclivities of modern architects may determine the "choice of one type rather than another among the "numerous examples furnished by Italian masters. But "it is not possible that either Greek or Gothic should "permanently take the place assigned to neo-Roman "architecture in the public buildings of European "capitals."

Granting his assumption that architects must copy something, I agree with him; but I do not grant his assumption; if I did, both this and the last course of lectures would have been time wasted, both for the speaker and for his hearers. I say that architecture is an organic art that must change with our knowledge and skill in construction, more particularly when we have materials of vast power scarcely known to the ancients. I say, too, that we have new tastes and different emotions to express. We must learn from the past the language of architecture and the methods by which emotion has been produced, and when this language and these methods have been learnt, we must all try to express the emotions of our day. If emotions be but feeble now, the time may come when they

* *The Architectural Works of W. of Wykeham.* C. R. Cockerell. 8vo. 1846. Pamphlet.

will be stronger, and when they will be more earnestly desired. There have been some great movements, even in my time, that I hope promise well; one certainly does – the pursuit of truth. Speaking of the intellect, the pursuit of truth is now getting to be looked on as man's highest duty, and we shall eventually have temples to it. We are also coming to believe that the investigation of the laws that govern the world and those parts of the universe that are within our ken are the most valuable parts of knowledge; few will dissent from this opinion, for the slight glimpses we have gained have not only made us like the fabled magicians of old, and cut us adrift from the past world, but have added enormously to our power, our comfort, and our wealth.

The putting the keys to knowledge in the hands of the rising generation must have striking results, and the passing of every child through the Board School sieve, and making what openings we can for those specially gifted to use their gifts, must, if not mismanaged, greatly add to the effective power of the country. Democracy, again, is a vast power, which we hope the sagacity of the nation will direct in the right way. One cannot help thinking that workmen will learn that they cannot raise their wages by being idle, nor by destroying the wealth of the country, and may therefore use the wealth they now squander in strikes for building themselves magnificent halls which will throw the halls of the Confraternities (*Scuole*) of Venice into the shade. We may also hope that moral philosophy will be greatly extended on a new basis, and that the multitudes who go to learn its lessons may desire to be housed conformably with the importance of the subject; and lastly that our legislators may learn that the most striking lessons can be given to the bulk of men by the fine arts alone.

PARLIAMENTARY.

Light and Air.

The Science Committee have, in accordance with the resolution passed at the General Meeting held 13th March 1893,* reconsidered their Report with regard to the amendment of existing legislation as to light and air, and recommend to the Council of the Institute that they should ask the London County Council to include in the "Bill to Consolidate and Amend the enactments relating to Streets and Buildings in London" clauses similar in effect to the following:—

I.—That any person proposing to erect, or to alter, or re-erect a building of a greater height than the existing or previously existing building shall serve a notice of his intention upon the owner or owners of adjacent properties, this notice to be accompanied by so much of his plans, sections, and elevations as will show the proposed alterations or increased dimensions of his building; and in the same notice he shall nominate a surveyor to act on his behalf, as under the Metropolitan Building Act 1855, Section 85.

II.—That, in the event of a difference arising, the neighbouring owner and the building owner shall proceed in accordance with the provisions of the Metropolitan Building Act 1855, Section 85, Subsections 6, 7 (except the last paragraph), 8, 9, and 10.

III.—That all subsequent proceedings up to the award shall be in accordance with the proceedings under the before-named sections of the Metropolitan Building Act.

IV.—That, in the event of either party refusing to accept the award, he shall have power, within one month from the publication of the said award, to appeal to one of the official referees, who shall sit with a professional assessor, to be appointed by the President of the Local Government Board or the Home Secretary, unless the parties agree on an assessor within seven days after giving such notice of appeal.

V.—That the decision of the official referee shall be final, and the costs shall be in his discretion.

VI.—That after the passing of the Act, in which the foregoing clauses shall be incorporated, the owner of any tenement not at the time servient to some neighbouring tenement, but over which such neighbouring tenement would in course of time acquire dominant rights of light, shall serve upon the owner of such neighbouring tenement a formal notice, in form and manner to be prescribed in the Act, and shall advertise the same in the daily papers, and put a notice in a conspicuous position adjacent or opposite to the lights in question, and such notice shall have the same effect as though an interruption had been submitted to for one year immediately previous to the date of the service of such notice.

* See "Minutes" in *The R.I.B.A. Journal*, N.S. Vol. IX. p. 213.

LEGAL.

Building used for purposes of Trade—New Building.

WALLEN *v.* HOLLAND AND HANNEN.

HOLLAND AND HANNEN (*appellants*) *v.* WALLEN (*respondent*).

The reports of the above-named cases, which appeared in *The Times* of the 18th of April 1893 and 22nd of February 1894, and are hereunder printed, give a fair idea of this prolonged case, and will show how desirable it is that such differences should be settled before the work is completed.

The case of Wallen *v.* Holland and Hannen [heard on the 14th April 1893] raised a question of great importance to the owners of large business premises in the metropolis as to the way in which the premises may be constructed, enlarged, and extended with reference to the rules under the Building Act requiring such buildings to be divided by internal walls. It was an appeal by Holland and Hannen, the eminent builders, against an order of a police magistrate directing them to comply in this respect with the requirements of the Building Act in the building now going on for the extension of Messrs. Shoolbred's extensive premises in Tottenham Court Road. Under the Act of 1855 (18 and 19 Vict., c. 122, section 27), the following rules are to be observed (as to new buildings) as to the separation of buildings and limitations of their areas:—Section 4 requires that every warehouse or other building used either wholly or in part for the purposes of trade and manufacture containing more than 216,000 cubic feet shall be divided by party-walls, so that the contents of each division shall not exceed that number of cubic feet; and when any building has been taken down to an extent exceeding half, the rebuilding is to be deemed a "new building," but the point that it was not so was not taken before the magistrate. The block of buildings now being erected between Tottenham Court Road and Grafton Street is to be 87 feet high, and to contain eight floors, separated by means of iron filled in with concrete, but not divided by party-walls according to the above rule, and the external walls were to contain 289,000 cubic feet, but by the floors would be separated into much smaller areas. The ground floor is to be used for the ordinary purposes of a shop, the floors above to be used for dining and refreshment rooms, and the uppermost floor for a kitchen, scullery, &c. The magistrate considered that the building was not divided by party-walls, as required by the rule, and made an order that the provisions of the Act in that respect should be complied with, but stated a case, on which the builders appealed.

Mr. Finlay, Q.C. (with Mr. Bullen), appeared for them, and argued the case on their behalf, contending that the building did not come within the rule at all, not being a "warehouse or other building used wholly or in part for "the purposes of trade or manufacture." [Mr. Justice Kennedy.—What do you conceive to be the object of the rule?] To provide against fire. [Mr. Baron Pollock.—You may have a shop of enormous area, the roof being supported by pillars, and not party walls.] There are fire-proof floors. The case is not within the rule, for it is not a "new building;" it is an extension only, and more than half is old. Then, even if it is within the rule, the space is subdivided by the fire-proof floors. The question whether it is a new building was not argued before the magistrate. [Mr. Baron Pollock.—Is it conceded?]

Mr. Cripps, Q.C., who with Mr. Daldy appeared for the surveyor, said it was not. On the contrary, he contended that it was a new building.

Mr. Finlay said it was a case of great hardship if this order was to be upheld, for it would involve an enormous expense, probably £20,000, as it would involve taking off two floors and rebuilding. To have to divide the shop by a party wall would also be an immense inconvenience and expense.

The Court said it was very material to have it found as a fact whether or not it was a new building, and sent it back to the magistrate to be restated on that point.

The case came on again before the Divisional Court (Mr. Justice Mathew and Mr. Justice Cave), and is reported in *The Times* of the 22nd ult. as follows:—

The questions in this case had arisen out of the extension by Messrs. Shoolbred of their large business premises in Grafton Street, Tottenham Court Road, by taking down two old houses and including their site. In March 1892 their builders, Holland & Hannen, gave notice to the district surveyor that the intended use of the building is a "shop and dwelling-house" and under the head of "additions" for the erection of a building. The buildings were commenced, and in August 1892 the surveyor, in accordance with section 45 of the Act, gave a notice in writing to the builders, setting forth, "as contrary to the "Act," "that the additional building exceeds 216,000 "cubic feet, and is not divided by party walls in such "manner that the contents of each division thereof shall "not exceed that area, the premises to which the addition "is made being used, wholly or in part, for purposes of "trade." This was under section 27, rule 4, of the Building Act. "Every warehouse or other building used either "wholly or in part for the purposes of trade or manufac-"ture containing more than 216,000 cubic feet shall be "divided by a party wall in such manner that the contents "of each division thereof shall not exceed the above "number of cubic feet." The building consisted of eight floors and was 87 feet in height, and was being erected as, and was intended to form, an extension of the premises of Shoolbred & Co., and when completed was to be used thus—the basement for the purpose of packing goods, the ground floor as an ordinary retail shop for the sale of goods, and the floors above as dining-rooms, sculleries, and kitchens. It was not, however, intended to be inhabited as a dwelling-house. The floor which supports the kitchen had iron beams 6 inches deep and 4 feet apart, with steel cross beams 2 feet apart, the space between being filled in with concrete composed of coal breeze and Portland cement, and of the thickness of 7 inches, increased by a tile pavement at top and plaster ceiling, altogether 9½ inches in thickness. There were four openings intended for lifts running through the concrete formation, the size of which varied, but one of them was 14 feet long and 12 feet wide. A staircase led from Grafton Street to the top of the building, and on each floor was a fire-proof landing, from which there was an entrance to the several floors, closed by two iron doors. The cubical contents of th whole building were 289,456 feet, inclusive of the staircase, which was 16,656 feet. The cubical contents above the concrete floor were 62,000 feet. The building being continued notwithstanding the surveyor's notice, he took out a summons against the builders under the Act, which led to an order against them. On their part it was contended that the building was not a "warehouse or other building "used wholly or in part for the purposes of trade" within section 27, and that the latter words referred to other buildings *ejusdem generis* with warehouses; and that even if the building was within the enactment, the concrete floor was a "party wall" within the Act, and satisfied the enactment, and that the divisions of the building above and below it did not separately contain more than 216,000 cubic feet, and that therefore the rule in section 27 had been complied with. But the magistrate, the cubical contents of the building within the external walls being in all 289,456 feet, was of opinion that the building was within the enactment as a building used in part for the purposes of trade, and was not divided by a party wall, so as to bring each division within the prescribed limit of 216,000 cubic feet, the concrete floor not being in accordance with the statutory requirements of a party wall, and having openings forbidden in a party wall, and he made an order against the builders—subject to a case, on the questions (1) Is the building "a warehouse" or other building used wholly or in part for the purposes of trade? (2) Is the concrete floor which separates the the two upper from the lower floors a "party-wall"? The case had come on and had been partly argued on a former occasion [see above], when a further point was raised as to whether the building was a new building under the Act, on which the case was sent back to the magistrate, who, however, did not alter his statement of the case, conceiving it virtually sufficient on that point.

Mr. Finlay, Q.C., and Mr. Grain argued the case for the builders. Mr. Cripps, Q.C., and Mr. Daldy argued for the County Council in support of the magistrate's decision.

Mr. Justice Mathew, in giving judgment on the 21st ult., said Messrs. Shoolbred & Co. had desired to remove some old buildings and throw the site into their premises, thus forming an extension of the adjoining buildings. It was contended that the building was not a new building within the Act, but that view would lead to the astonishing result that the provisions intended for the protection of the public against the danger of fire would be applicable if the buildings belonged to different owners, but not if the whole belonged to one. That could not have been intended by the Legislature. He had no doubt that, the new buildings being intended to be occupied with the old, the whole building came within section 10; and, besides, section 9 would clearly be applicable, what was done being to add to or alter the former building. The building clearly came within rule 4 of section 27. The "building" there mentioned was not to be construed as "warehouse building." The language of the enactment was clear and distinct, and the case was clearly within the language of the enactment. The order, therefore, was right, and the appeal must be dismissed.

Mr. Justice Cave was of the same opinion. The case, he said, as originally stated raised two questions under section 27—(1) that the building was not a warehouse or other building used for purposes of trade; and (2) that the concrete floor was a "party wall" within the enactment. But as to the first, the construction suggested for the defendants gave no effect to the words "used for purposes of trade;" and as to the second point, it overlooked the distinction between "floors" and "party" walls, the latter being vertical and the others horizontal, and the enactment clearly meaning party walls in the ordinary sense. Then another point was sought to be raised, but it was as little tenable as the others.